# COAL AGE

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THERE are some questions pertaining to the operation of coal mines that are as old as the industry itself, and still have not been settled.

When emergency arises, and lives and property are endangered, it is immediate and definite action that's wanted, not discussion and conjecture.

Positive plans to combat every possible peril should be clearly in mind. Accidents that are foreseen are already half overcome. The man who completes a job in his head before he puts hand to it, is master in fact.

* * *

Mine fires furnish a problem on which we largely disagree. A case in hand that typifies the situation is indicated by a letter we received a few days ago from the manager of a large coal company.

He says: "At 8:15 on Wednesday morning, I was called to our No. 7 colliery because of a fire that had broken out in the last crosscut connecting the 10th West entry with its air course. On arriving at the shaft, I learned that all the men had gone to their places in the distant workings. The mine generates some gas, but is not considered dangerous. Open lights are used.

"At the shaft, hoisting of coal had already begun. I went underground immediately with the superintendent of No. 7 and was also accompanied by the superintendent of our nearby colliery, No. 4. The superintendent of this latter mine had been summoned because of his familiarity with the No. 7 workings, since it was he who had originally opened the mine and who had been in charge of its development up to within a year.

"On entering the 10th West entry, we encountered smoke and a high temperature, and were informed by our foreman and fireboss, who were directing hastily formed relay squads in fighting the fire, that the flames were likely to get beyond control.

"I called a hurried conference to determine the best plan of action in case we would have to isolate the fire. The superintendent and foreman of No. 7 advised placing the first stopping on the No. 10 main, or intake side of the trouble; the No. 4 superintendent and the fireboss at No. 7 were agreed that the first wall should be erected on the No. 10 air course or return side of the fire.

"A little later the flames were extinguished, but I have not forgotten the difference of opinion concerning the proper plan of attack. Therefore, disregarding local conditions that modify any specific rule, is it not possible to prescribe in general whether a fire at the face of a pair of entries should be sealed off, first on the intake, or first on the return side?"

* * *

Of all the serious problems that confront the coal industry, none is more deserving of immediate attention than this question of overcoming a mine fire. It is an interesting subject and one that cannot be dismissed with a wave of the hand or a sentence of speech.

We believe, therefore, that great good will result from a discussion of the problem, and we want every reader of COAL AGE who has an idea on the subject to write us his views.

Conditions differ today from what they were years ago. Rescue helmets enable us to work in smoke and gases—a feat heretofore impossible. Theories, like machines and men, wear out. To succeed we must fall in with time's changes. Those who swim against the current will go down in the eddy.

Were the superintendent and foreman at No. 7 right in their judgment, or do you agree with the opinion of the No. 4 superintendent and the No. 7 fireboss?

# Coal Mine Ventilating Equipment

By W. M. Weigel *

**Of the three classes of mechanical ventilators, the positive blower is least adapted and the centrifugal fan best adapted for use in ventilating mines. The second article of a series on mechanical ventilators.**

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Mechanical ventilators may be classified according to the principle on which they operate, as follows: 1. Positive blowers, which admit, confine and then displace a fixed volume of air at each revolution. 2. Centrifugal fans or blowers, which by rotating at a high velocity, impart a centrifugal motion to the air between the blades and thus tend to create a partial vacuum at the center of the fan. 3. Disk or propeller fans, which by means of revolving vanes or blades, set at an angle to the plane of rotation push or propel the air away from one side of the blades, thus creating a partial vacuum on the opposite side.

### Positive Blowers

Positive blowers of either the rotating or reciprocating type are now seldom employed as mine ventilators. Their excessive weight for a given capacity, and the large amount of machine work required in their construction make the cost of machines having a large volumetric capacity prohibitive when compared with that of fans. Furthermore, they require skilled attention and careful adjustment, which increases their cost of operation.

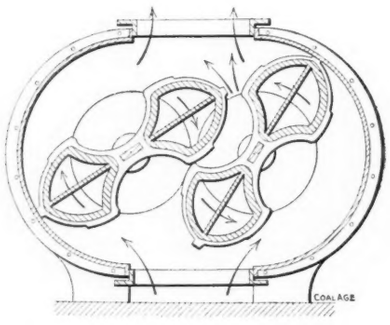


Fig. 1. Sectional View of Green Blower

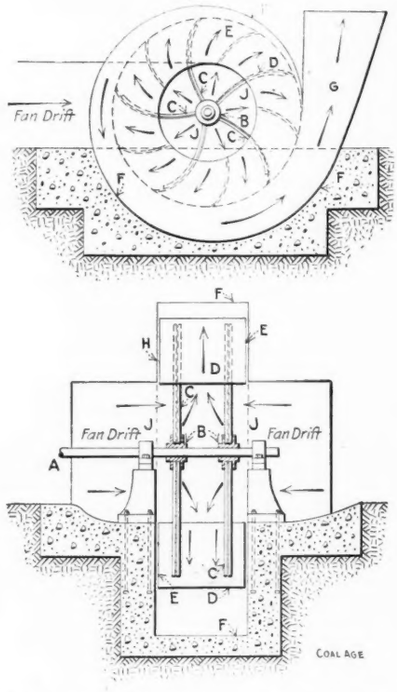


Fig. 2. Sectional Views of Centrifugal Fan

Among the rotary blowers of this description are the Root, Connorsville, Green and Baker. The first three of these are quite similar in construction, and consist of two interlocking impellers, which revolve side by side, or one above the other, in an inclosing case without, however, coming into sliding contact with the sides of the case. Both the casing and impellers are made of cast iron accurately machined, and the fact that these surfaces must be mathematically true, adds greatly to their cost of manufacture. Perfectly made and designed impellers should roll together without friction, the points of each which may be in contact at any time always traveling at the same speed. Fig. 1 is a sectional view of a Green blower taken at right angles to the axis of the impellers; the arrows show the direction of rotation and movement of the air. At every half revolution, each impeller incloses the air between itself and its side of the case and discharges it through the outlet at the top. The impellers are geared together outside the case, preferably at both ends. These gears are accurately cut to reduce friction, insure quiet running and perfect uniformity of rotation of the two impellers. Fig. 4 shows a Connorsville blower direct-connected to a horizontal engine on the same bedplate.

The Baker positive blower differs from the Root type in having one main impeller which receives its power from the engine or motor and two auxiliary impellers or rotating valves, which admit the air during the intake part of the revolution and prevent its escape during the discharge period.

Reciprocating blowers are similar in construction and operation to blowing engines or air compressors, that is, the air is alternately drawn into and discharged from a cylinder by means of a piston, which may be driven by any form of motor, but is usually directly connected to a steam cylinder. However, their application is so limited as not to warrant further discussion.

All positive blowers are primarily intended to operate against pressures of 1 lb. or more per square inch. They do not however, discharge the air at a greater pressure than that necessary to overcome the resistance. But because they are designed to withstand and maintain such high pressures, their mechanical efficiencies are poor when handling the low pressure required for mine ventilation, which seldom exceeds 20 to 25 lb. per square foot. This fact is due to the excessive weight of their moving parts and their frictional losses.

### Centrifugal Fans.

A centrifugal fan is shown in Fig. 2. There is a horizontal shaft supported by

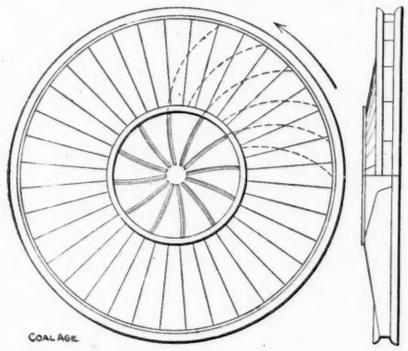


Fig. 3. Waddle Centrifugal-fan Wheel

suitable bearings and between bearings the shaft is fitted with hubs rigidly keyed to it. From these hubs radiate arms or spokes to which vanes or blades are attached. The wheel is usually inclosed in a spiral casing with an opening in one or both sides at the center and one in the circumference. As the fan revolves, air is drawn in through the center opening. It then passes between the blades into the spiral casing and out through the opening in the circumference. If the fan draws air through its central opening from an inclosed space, such as a mine, it is said to be an exhauster, and if it delivers to an inclosed space through the opening in its circumference, it is then said to be a blower. The action of the fan is the same in both cases. The only difference being that

when exhausting the pressure within the inclosed space is less than, and when blowing greater than the atmospheric pressure.

Fig. 2 illustrates the general construction of a centrifugal fan and also shows the direction of the air currents, through one having an inlet on each side. *A* is the fan shaft; *B*, the hubs carrying the arms, and *C*, the arms which carry the vanes or blades *D*. The cheeks or side plates *E* are fastened to the ends of the blades and rotate with them. Their purpose is to stiffen the wheel and prevent the air from slipping around the ends of the blades as the fan revolves. The spiral casing *F* starts close to the circumference of the wheel and gradually enlarges until, having passed completely around, it widens out into the chimney or discharge opening, *G*. The fan shown in Fig. 2 is designed for exhausting. For blowing the discharge would generally pass off in a horizontal or downward direction. The sides plates of the spiral casing are shown at *H*, and the central air inlets at *J J*. Usually in an installation of this kind, the fan foundation forms the lower part of the spiral.

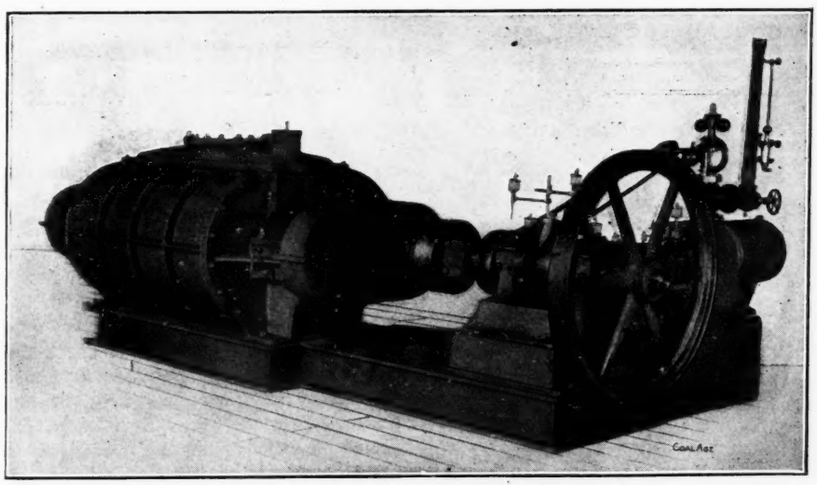

FIG. 4. CONNORSVILLE CYCLOIDAL BLOWER

The blades extend from the circumference of the inlet to the circumference of the wheel. There is no standard practice as to their shape and position. In some fans they are radial planes, in others they are convex toward the direction of rotation and slope backward. Some blades slope backward but have their tips bent forward into a radial direction. Others are planes but instead of being in a radial position, slope backward. In some extreme cases the blades are concave toward the direction of rotation.

### THE WADDLE TYPE OF FAN

A type of centrifugal fan used to some extent in England and Europe has no spiral casing, the air upon being discharged from between the vanes passing directly into the surrounding atmosphere. One form, the Waddle, is shown in Fig. 3, and consists of alternating long and short curved vanes fixed between and attached to two disks, one of which has a circular opening at the center for admitting the air from the mine. The fan drift must fit closely around this opening, and yet allow sufficient play for the free rotation of the fan. The solid disk is a plane, and the other disk is slightly coned, gradually approaching the flat disk toward the circumference. This reduction of sectional area is so regulated that the product obtained by multiplying the angular velocity at any point by the sectional area between any two vanes and the sides is a constant; which fact is supposed to keep the fan full of air. Beyond the tips of the vanes the disks diverge to such an extent that the area of the periphery at the edges of the disks is a little more than double the area at the tips of the vanes. This is done to reduce the velocity of the air as it is discharged into the atmosphere and increase the efficiency of the fan.

Waddle fans are made with large diameters compared to their axial length. The dimensions of a typical fan are:

| | |
|---|---|
| Extreme diameter | 36 ft. 4 in. |
| Diameter of tips of vanes | 35 ft. 0 in. |
| Diameter of inlet | 13 ft. 6 in. |
| Width of vanes at tip | 1 ft. 1½ in. |
| Width at extreme periphery | 2 ft. 2¾ in. |

In the latest forms the difference between the extreme diameter and the diameter at tips of blades is greater than in the above case. It will be noted that the long blades extend to the center of the fan; and that the portion of the blade between the fan center and the edge of the inlet is nearly radial in position, while the balance of the blade, like all the short blades, is curved backward from the direction of rotation. A few of the blades are shown by the dotted lines in the figure.

As the discharge from these open type fans takes place around their whole periphery, strong winds may interfere with their action at times. Further, the pressure is only one-half that developed by an inclosed fan of the same diameter running at the same speed as will be shown later. This, however, should have no effect on the mechanical efficiency of the fan. Tests of Waddle fans showing a mechanical efficiency of 65 per cent. have been published, but it is extremely doubtful if such results are possible. The error is, however, undoubtedly due to inaccuracy of measurements, especially of the volume and pressure of the air, and not intentional. It should also be noted that this type of fan is suitable only for installation as an exhauster, because it discharges around its entire periphery.

## Machinery for Cutting Coal

An interesting paper on coal-cutting machinery, describing various types of rotary and percussive machines and comparing their advantages, was read by W. B. Shaw at a recent meeting of the Manchester Association of Engineers.

Mr. Shaw explained that the power employed for driving the coal cutter is compressed air or electricity, and though machines have been designed for driving by means of a haulage rope, no practical machine of such a type is at present working. The chief recommendation of compressed air is the absence of any danger of firing gas, or risk of possible shock to the machinemen; it is also a simpler apparatus and there is little danger of its being damaged by overloading. Its efficiency in power consumption is much lower than that of electricity.

The suspicion thrown upon electricity in connection with certain recent colliery explosions—a suspicion which was scarcely justified by the facts—has led to much serious thought on the risk in the use of electricity for coal cutting, and is likely to result in legislation imposing considerable restrictions along this line. Though this is leading to a considerable increase in the use of compressed air and has the appearance of being a setback to electrical cutting, it will no doubt be to its benefit in the end. It will result in still greater care and thought being given to the design of electrical cutters, with consequent improvements in those points which make for safety and at the same time reliability. With a clearer definition of where electricity might be used, the colliery manager, when he decides to install electrical cutters, will do so with a feeling of greater confidence.

Any method of mining or handling coal that will materially reduce the percentage of slack without increasing the cost of operation is worth taking up.

# Railroad Tracks for Soft Coal Mines

By M. L. Hyde*

**The railroad-track plan is one of the first problems of a new mining plant. The various considerations that usually determine a layout of this kind are discussed together with several typical examples.**

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While a great many articles are published from time to time regarding the surface arrangement of modern bituminous mines, only incidental mention is ever made in them of the railroad yards, and no definite information is usually given as to why the particular layouts are adopted. As the track plan is one of the first problems which confront the operator who contemplates building a new plant, the subject deserves more extended consideration.

Under present conditions nearly all bituminous mines are compelled to load from two to six grades of prepared coal in order to realize the maximum returns on the investment involved; and since every grade has a value in direct ratio to its size, it is desirable that each be loaded from the tipple or washer directly into its respective car, with as little handling as possible.

### The Cost of Breakage

Particular attention is called to the fact that breakage is expensive to the operator in more ways than one, because not only is the average market value per ton mined reduced as the percentage of small sizes is increased, but also the first cost and the operating cost of the tipple itself are greater for the type which produces much breakage than for that in which the coal is handled in a thin uniform ribbon over shaker-picking tables and screens, from the time it leaves the mine car until it is lowered into the railroad car for shipment. A comparison of the cost of tipples having gravity or revolving screens, storage bins, etc., with that of the clean-cut, low structures, housing an equipment of shakers, will confirm this statement.

The practice of carrying bituminous coal to storage pockets in the tipple and subsequently drawing it out into railroad cars for shipment, should be avoided as far as possible. Coal loaded directly from a bin carries with it 5 to 15 per cent. of material, which has been crushed in the storage process to sizes below the standard, and, in order to hold the trade, this degraded material must be removed by rescreening the coal as it leaves the pockets.

If the full value is to be realized from these lip screenings, as they are called, they should be sent back to the main screens. For example, take a mine shipping the following grades: Three-inch lump, at $1.75 per ton; 1¼- to 3-in. egg, at $1.50 per ton; ¾- to 1¼-in. nut, at $1.10 per ton; and ¾-in. slack, at 75c. per ton. It would not be advisable to take all the 1¼-in. lip screenings from the stored egg coal and throw them into the slack, nor should they be put in with the nut coal. The proper method is to carry them all back to the screens and get as much nut as possible from the mixture. Attempts have been made to mix a small amount of the fines with the larger sizes, or to take egg coal from the run-of-mine and ship it separately while still holding up the value of both coals. With egg at $1.50 and run-of-mine at $1.20, it will readily be seen that this is a profitable subterfuge, but nevertheless one that will eventually bring the perpetrator to grief.

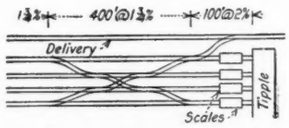


Fig. 1. Empty Yard

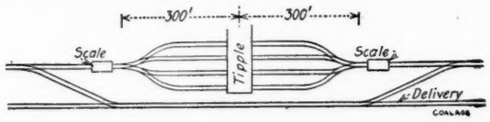


Fig. 2. Tipple Tracks and Scales

### Loading Direct from Screens to Car

All this leads to the conclusion that each grade of coal should be laid directly from the screen preparing it into the car, thus requiring a separate railroad track for each size of coal. Now, while this is a desirable solution, yet, owing to surface conditions, it is not always practicable; in fact, seldom more than three to five tracks can be arranged for, in which case the three to five largest grades of coal should be loaded directly, and the remaining smaller sizes sent to storage bins.

Wherever bins are used it is advisable to build them as low as possible, in order to avoid bringing any greater weight than absolutely necessary on the coal which rests on the bottom. A satisfactory hoppered-bottom bin, having a capacity of 60 tons, or one car, can be built approximately 10x18 ft. in plan and 32 ft. high overall, with 14 ft. clearance from top of rail to discharge gate.

### Yard Layout

The layout of tracks for railroad cars at a mine should provide in general for an empty storage yard above the tipple, leading to an independent system of loading tracks under the tipple, and thence in turn to a loaded storage yard below. Both the empty and loaded storage yards should accommodate enough cars for a day's run, requiring 1000 ft. of track in each yard per 1000 tons capacity of the mine. If the operation is large enough to own a switching locomotive, or to be served several times a day by the railroad, the size of the yard may, of course, be decreased, although it is usually not advisable to do so.

The empty yard should be laid off with a grade of 1¾ per cent. in favor of the empties, and should preferably have as many tracks as there are loading tracks under the tipple. In Fig. 1 is shown an empty yard with a scissors cross-over, allowing cars on any track in the yard to go to any track under the tipple. This affords a desirable layout, since in most cases all cars will be handled in a straight line. Moreover, it gives a maximum amount of storage room at a minimum distance above the tipple. One disadvantage of this yard, however, is that scales are required on every track, in case the cars must be weighed at the mine.

### Layout for Track Scales

Where weighing is required, the layout shown in Fig. 2 is to be preferred. While this layout requires more room for a given number of cars and forces all but those on one track to round the curve and take the turnout, with a consequent risk of derailment and an increased amount of labor to start them off the scales, and also results in a more congested condition under the tipple, yet, on the other hand, it allows of bringing all the cars to one scale, and thus materially decreases the total cost of the yard.

The yard tracks should be on at least 12-ft. centers, and if the layout shown in Fig. 2 is adopted, may consist of from one to as many tracks as desired. The number will be governed by the ground conditions. Ordinarily, it is cheaper to grade for four tracks one-quarter of the total required length than for one track the full length, and time is saved on the part of the yard men in going after cars.

From a distance of 100 ft. above the tipple to a point 100 ft. below it, the track should be on a tangent, with a favorable grade of 2 per cent., this being required to insure that the cars will move forward readily a few feet at a time during the loading process. From this latter point the ladder should be run in on a 1¾ per cent. grade, and the loaded yard entered on a 1½ per cent. grade. After

a couple of hundred feet the grade in the loaded yard should be reduced to 1¼ per cent. It will be noted that in the arrangement shown in Fig. 2 only one empty and one loaded track scale are required.

### Objections to Scales under Tipple

While at some mines the scales are placed directly under the tipple, this is not an economical method of weighing. In the first place, a separate scale is required on each track and in order that the empty car may be weighed with its front end under the loading chute and the loaded car weighed with its rear end under the same chute, the scales must be at least 75 ft. long. This is not only an expensive arrangement but it interferes with the continuous operation of the tipple since a fresh empty cannot be spotted until the loaded car has been weighed and pushed off the scale, thus involving an unnecessary loss of about a minute between each car, and also requiring an extra man.

In laying out the yards 80- or 90-lb. rails on 6x8-in. sawed oak ties with No. 7 turnouts and 12½-deg. curves should be used. This equipment will insure the grades remaining uniform and the curves will be sufficiently easy not to bind the cars. The ties should be spaced on 18-in. centers throughout the yard and their size should be increased to 6x10 in. wherever turnouts are located.

The track centers under the tipple should be 16 ft. between the lump-coal track and the next one inside, and 14 ft. between all others. The 16-ft. centers are required for the proper placing of the lump-coal loading chutes (especially where box cars are to be loaded) and for the tipple platforms, which are built on a level with the brakemen's step on the car to enable trimmers to pass from one track to another without loss of time and without danger.

The centers between the lump and the run-around tracks should be 14 ft. if a box-car loader is not used, and 30 ft. if it is. The run-around track should be so placed that the locomotive will never have to pass over the track scales and can deliver the empties and remove the loads with a minimum loss of time and without obstructing the ladder track.

Care should also be exercised in laying out the tracks, that cars carrying supplies may be switched onto a siding until unloaded and then fed over the empty scales to the tipple and used for coal if desired, all without interference with the flow of cars to and from the tipple.

### Method of Handling Cars

One of the best methods of handling cars will be found to be as follows: The locomotive engineer in getting his trip of empties together places any supply cars there may be at the rear end, next to the locomotive, and then pushes the trip onto the run-around track and thence into the empty yard, after which he leaves the supply cars on their siding. He then travels over the run-around track to the far end of the loaded yard and pulls the loads away, or in some cases he pulls the loads from the rear end of the yard back onto the run-around.

After the cars have been placed by the locomotive in the empty yard, either one or two yardmen run them over the scales in trips of three to six and distribute them on the loading tracks, two or three cars to each track, riding each lot until the front of the first car is under the tipple loading chute, at which point the cars should be connected to a rope leading to a car retarder. This latter is an ingenious device, costing about $150, by means of which trips of from one to three cars are handled during the process of loading. It can be operated by the trimmer or dumper without requiring a man on the car.

The general idea of the retarder is that of leading a rope to the front car of the trip, and thence back to a small winding drum controlled by a band brake. With a grade of 2 per cent. under the tipple and all the brakes off, the cars will tend to run and thus maintain a tension in the rope. By easing up on the brake, the trip is allowed to move forward under the control of the operator until all three cars have been loaded, when the rope is detached and automatically rewound on the drum until the hook end comes back to the tipple and is attached to a second trip of empties. With a retarder for each track one man can control three car trips on two tracks at the same time or two men can control three car trips on four tracks. The yardmen jump the trip after it is unhooked and take it over the scales to the loaded yard. This system will allow of handling cars under a four-track tipple with only two spotters and two yardmen for a 3000-ton plant.

### General Considerations

All railroad ties should be of sound, live white oak 6x8 in. by 8 ft. long, set on 18-in. centers. Six hundred and sixty-seven ties will be required per 1000 ft. of track. Switch ties are furnished by the lumber mills, already cut to suit the given switch, and should be of 6x10-in. material. For a No. 7 turn-out 2600 bd.ft. are required and for a No. 10 turnout 3200 ft. board measure.

Rails should be of either 80- or 90-lb. sections and 24 tons of 80-lb., or 27 of 90-lb. rails are required per 1000 ft. of track. Assuming average lengths of 30 ft. for the rails, 67 pairs of splices and 268 track bolts will be required per 1000 ft. The angle-type splice plate, such as the Bonzano, is to be preferred. Track bolts should be 4¾x⅞ in. with oval heads. They are furnished in 200-lb. kegs carrying 149 bolts each.

With 667 ties required per 1000 ft. of track, 2668 5½x⅞-in. railroad spikes will be needed, amounting to 7 1/10 kegs of 200 lb. each. The plain uniform spike with a clean-cutting wedge-shaped end will give the best results. No. 7 turnouts, complete with rigid frogs, point switches and stands, will cost about $100 laid. No. 10 turnouts, complete with spring-rail frogs, point switches and stands, will cost about $150 laid. The former can be used throughout the entire yard except at the cross-over to the main line, where the No. 10 should always be furnished. Stub switches should never be used.

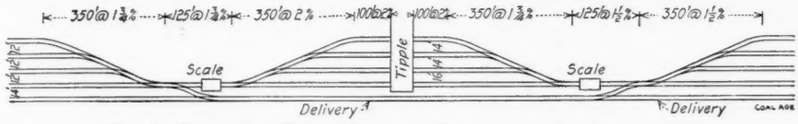


Fig. 3. Complete Track Layout, Empty and Loaded Scales

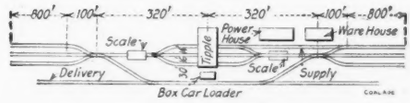


Fig. 4. Yard Plan

A 44-ft. long 60-ton track scale for empty cars, set in a concrete pit, will cost approximately $1500. A 50-ft. 125-ton track scale for loaded cars, set as above, will cost $1750. These prices cover excavation, concrete, lumber, the scale and setting.

The surfacing of the yard will ordinarily be done with refuse ballast from the mine. All ballast should be crushed to pass through a 2½-in. ring and should be laid 6 in. deep under the ties. On this basis 250 cu.yd. of ballast will be required per 1000 ft. of track.

The advisability of having a yard laid out by competent engineers cannot be too strongly emphasized. Once a yard has been poorly laid out and graded, it means a great deal of money and lost working time to put it in shape.

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A remarkable record was recently made by a puncher coal cutter made by the Hardy Patent Pick Co., of Sheffield, Eng. The work was done on a longwall face in a Durham colliery on a seam 3 ft. thick. The machine, which was handled by two men, started at 8:15 a.m. and finished at 3.20 p.m. The air pressure was from 45 lb. to 50 lb. per sq.in., and the length of the face cut was 47 yd., the depth 5 ft., and the maximum cutting speed was 180 sq.ft. per hour.

# A Test for Coal Washing Economy

Special Correspondence

**An apparatus is described by means of which a characteristic curve may be obtained for any coal. This curve shows at a glance what results may be expected from washing the coal in an effort to bring its percentage of ash within a certain figure.**

NOTE—From "Revue universelle des Mines, de la Métallurgie," etc., Liège, Belgium, Article by R. A. Henry, director of the Hasard collieries.

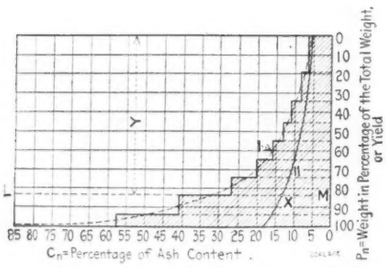
Devices for mechanically washing coal make two products which are commonly termed coal and rock, although neither is entirely one or the other; and the object of the process is to leave in the coal exactly the amount of ash specified by the purchaser, while at the same time discarding a minimum amount of coal with the refuse.

Of the numerous fuels which we have had occasion to study, none has contained particles of either absolutely pure coal or of rock entirely free from carbonaceous material; the particles of fuel are all more or less mixed with schists, and their ash content increases progressively, from those which are most nearly pure coal to those which are practically all rock.

If $Y$ is the yield in coal from the washing operation and $X$ the ash content of the washed coal, we have:

$$Y = f(X)$$

This function varies considerably with different fuels and by determining its values we are able to tell exactly the greater or less amount of waste which is entailed by reducing the percentage of ash and consequently enriching the coal.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X
M
85 80 75 70 65 60 55 50 45 40 35 30 25 20 15 10 5 0
Cn=Percentage of Ash Content
0 10 20 30 40 50 60 70 80 90 100
Pn=Weight in Percentage of the Total Weight, or Yield
COAL AGE

FIG. 1. DIAGRAM FOR DERIVING CHARACTERISTIC CURVE

These values can be obtained only experimentally; and in order to find them the apparatus which is here described was designed. It was constructed in the Van de Wyer shops, rue Haute, 17, Anvers, Belgium.

### DESCRIPTION OF THE APPARATUS AND METHOD OF USE

A bronze cylinder $B$ of exactly 100 mm. (3.93 in.) inside diameter is plunged into a reservoir $D$ filled with water, as shown in Fig. 2.

At the bottom of the cylinder a grate $E$, covered with a wire gauze, is held in place by two screws $S$ $S$.

Having placed in the tube about 1 liter (61 cu.in.) of the coal to be tested, the cylinder is raised in the reservoir, by making use of the handles $H$, and then let fall quite rapidly; in this way the water flows in the direction of the arrows and the various particles of coal become stratified in accordance with their specific gravities. For samples of very finely divided coal 30 to 40 strokes are necessary.

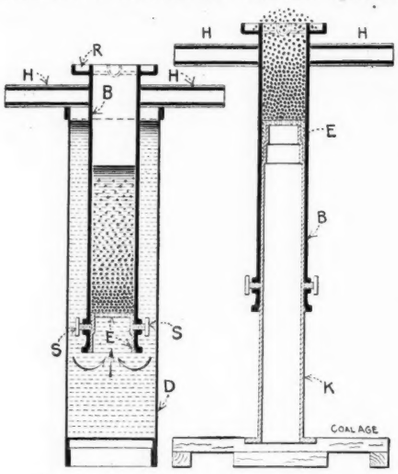



FIG. 2. APPARATUS FOR PREPARING SAMPLE

The deposit thus secured is made up of a series of elementary layers of weight $P_n$, Fig. 1., and ash content $C_n$. The apparatus, as we shall soon see, permits an exact division into perfectly horizontal layers practically as thin as may be desired.

Having separated the layers $P_1$, $P_2$ . . . . $P_n$, we dry and weigh them, and then determine their ash contents $C_1$, $C_2$ . . . . $C_n$.

The weights $P_n$ of the separate layers are laid out as ordinates, and arranged in the order of their superposition, the total weight being made equal to 100. At the middle of the height representing the weight of each stratum we lay out, as an abscissa, a distance $C_n$ proportional to its ash content, and we join the points obtained by a curve $I$, Fig. 1.

This curve gives the law of distribution of the ash in the sample of coal tested, and its area $\Sigma_0^{100} C_n P_n$ (represented by the shaded section of Fig. 1) gives the total weight of ash contained in the sample, of which the weight is 100.

The mean ordinate

$$X = \frac{\Sigma_0^{100} C_n \times P_n}{100}$$

is the ash content of the raw coal.

### SEPARATING THE BED OF COAL

Now the industrial operation of washing coal consists in separating the bed of coal into two layers. The upper part is the washed coal and the lower part the waste.

Let $L$ $M$, Fig. 1, be the plane of separation; then the upper part will have a mean ash content:

$$X_n = \frac{\Sigma_0^n C_n P_n}{Y_n};$$

the yield in the coal will be $Y_n$, and the loss due to the waste will be $(1 - Y_n)$

By varying the hight of the plane $L$ $M$,

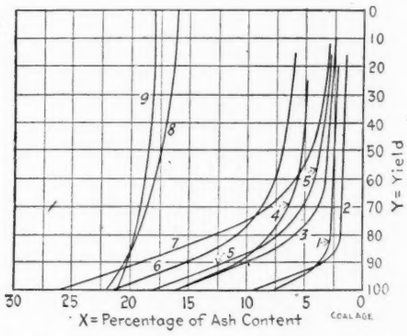



FIG. 3. CHARACTERISTIC CURVES OF VARIOUS FUELS

a simple substitution gives the corresponding values of the general equation:

$$X = \frac{\Sigma_0^{100} C_n P_n}{Y}.$$

*The locus of the point X is the required characteristic;* and this curve $I$ $I$ measures the inevitable loss which has to be sustained in treating a coal containing $X$ per cent. of ash.

The apparatus has been so designed as to permit an easy separation of the layers. In order to do this the tube $B$ is placed on the column $K$, the grate loosened by unscrewing $S$ $S$ and, when $B$ descends, it obliges the coal to fall into the gutter $R$. The screws $S$ $S$ permit this operation to be stopped when deemed proper; in other words, to limit the height of each layer.

By using a cutter which is rested on the top edge of the tube, all the coal which projects is horizontally cut off and

transferred to a receptacle. The successive samples thus obtained are then dried, weighed and incinerated, each of them giving a point of the desired curve.

### Practical Application

There are collected in the diagram, Fig. 3, a number of curves obtained for fine coals of ⅛-mm. size, coming from different places. It is noticeable that, for example, the samples Nos. 6 and 7, whose ash contents in the raw state (that is, for $Y = 100$ per cent.) are $X_6 = 21.3$ per cent. and $X_7 = 26$ per cent., respectively, will give the same yield in washed coal ($Y = 73$ per cent.) if we bring them to a common ash content of 8.75 per cent.

If it is required to enrich these products to a content of 7 per cent. ash, sample No. 6 will produce 47 per cent. yield and sample No. 7 will give 67 per cent. Thus we arrive at a result which at first thought would have been deemed paradoxical: No. 7, the more ashy in the raw state, leads to a loss almost twice as little as No. 6, to which incineration alone would have led us to attribute a superior value.

We note also that samples Nos. 8 and 9, which seem to be economical fuels, are not successfully cleaned by the process of washing. These curves vary with the different seams of coal, the size of the grains, the contents in pyrites, the presence of washing stones, etc Their interpretation, which is quite easily acquired, permits the engineer to draw conclusions unknown before the use of this method of investigation.

# Longwall and Conservation

By Sim Reynolds*

**Some interesting facts are brought out and seem to point conclusively to the eventual universal adoption of the longwall system. Comparisons are drawn between it and the room-and-pillar methods, showing enormous losses incidental to the use of the latter.**

*Mine superintendent, Marianna, Penn.

With the gradual depletion of our surface coal, the necessity of working to greater depths, and conserving our supplies, the longwall system of mining is continually gaining more prominence. That more coal men are being converted to this system is not to be questioned, and if we may omit the faults, the arguments in its favor are overwhelming. It is not, however, the purpose of this article to cover up the bad features, nor to eulogize the good ones, but to set forth as clearly as possible a comparison of the present methods of working, and changes which might be advantageously made.

In fairness to the reader it should be stated that in Great Britain, which is the home of longwall mining, there were 1600 lives lost in the mines in 1910. A method of mining having such a fearful mortality in one year, is far from being what we would desire, and yet it may be the best attainable. Another detrimental feature which should not be overlooked is that of surface caving, although it may be here stated that the longwall system is no worse in this respect than others.

The success of any method is, of course, contingent on adhering strictly to the approved lines of procedure. The tendency is to leave undone those things we should do, and do those things we should not, and this human perversity is about the only vital feature connected with mining which does not change.

### Eventual Adoption of Longwall Assured

It is becoming apparent that the next decade or two will see certain decided changes in mining methods. The newer generation will look back on the uneconomical systems of the old, and seek to remove the antiquated methods having such wasteful results. While longwall mining may not be the perfect system, it appears to embody the best methods attainable at the present time. The advantages of this system can be best shown by a comparison of the two methods on the same basis.

To the ultra-conservative who are not in sympathy with the impending change, we wish to call attention to the statement of an eminent consulting engineer, located in the Fairmont region in West Virginia, who is in direct touch with numerous mining operations throughout the United States. This authority says that many of the larger corporations, who can afford to make experiments, if thereby they have an even chance of making money in the end, are conducting certain portions of their work under all kinds and conditions appertaining to the longwall system. To prove these experiments takes time, and some day it is to be hoped an article will be published which will cover the more important of these essays into new methods.

### Necessity for Its Adoption

That there are some seams that it will be possible to work only by the longwall method is generally conceded and in the interest of the utmost possible conservation, there will probably some day be passed a sweeping edict covering all coal beds not yet mined. In the meantime, the companies which are trying out the different systems, will, upon the arrival of legislation on this subject, be in a position to say definitely just what they want.

The various conditions of its application would, of course, be determined by the local conditions, ellipse, circle or straight line being used, according to the usual circumstances governing the application of such rules. Whether it will produce the results extreme reformists would have us believe it will, is doubtful, particularly if the strata above it lay more than a good breaking distance in thickness. The opinion of the other side, who see in it nothing but expense and disastrous surface caves, is also equally doubtful.

For the sake of comparison of the results attainable by the different systems, a 1000-acre tract of land, with coal lying at a depth of 400 ft., will be assumed. By taking this depth as a basis, we give a conservative estimate of the possibilities of the longwall system on surface caving, which is about the only real fault that can be charged against it.

### Losses by Room-and-Pillar Methods

According to all available statistics, a conservative estimate of the average amount of coal recovered under our present systems of working would be about 60 per cent., and less in many instances. The total tonnage on a tract of this size would be 9,680,000 short tons and 60 per cent. of this would give an approximate tonnage of about 5,800,000, which means the loss of nearly 4,000,000 tons of coal. At an average price of $1 per ton, it is readily seen that the nation is $4,000,000 poorer as a result. The glaring fact that our national wealth is $4,000,000 less than it might have been because of development of a comparatively small industrial operation according to established rules, cannot be ignored, especially when it is remembered that this is a loss which no mortal ingenuity can ever repair.

The miner who can look back on boyhood days spent sweating over a "Blow-George," furnishing insufficient air to a brawny South Staffordshireman as he delved in search of a possible thick coal pillar, may be of the opinion that this coal is not entirely lost. But by far the greater part is lost once the strata has broken, while on the other hand, such losses on longwall work are evident and more or less susceptible to remedy.

### Surface Caving

In removing the entire seam some damage has perhaps resulted to the farmer, but not much, certainly, at a depth of 400 ft., and nothing beyond easy repairs. Where a total extraction has been effected on a 5-ft. seam having 100 ft. cover in certain of the Pennsylvania fields, the break has extended to the grass roots. Where this extraction has been several acres in extent and the break has been general over the entire area at once, it cannot be said that any appreciable damage has resulted. In this instance there was no packing whatever, as would ordinarily be the case in longwall workings. The conditions were simply 100 ft. of easily breaking roof with a clean fall of 5 feet.

Taking our previous example again, of 6 ft. of coal at a depth of 400 ft. worked by the longwall system and packed carefully, the result would by no means be so serious. Furthermore, it should not be forgotten that there are approximately 1000 square miles of coal in which the seams are 600 ft. or more below the surface.* At this latter depth it is doubtful if the strata would break to the surface, for it has been shown in the British mines that at a depth of 700 or 800 ft. work can be carried on successfully under the sea.

This proves conclusively that in average strata the highest fall reaches an apex far below that distance, and the miner who has had extensive experience in pillar drawing and is familiar with the quick oblique line that the ragged rock edges traverse toward a common juncture, will place the safety point much lower.

### Comparison of Results

Turning again to our example of a 1000-acre tract, and assuming this to have been worked by the longwall system which has resulted in certain damage to the surface, a comparison of this surface damage, with the additional extraction obtained, may be made. Taking the mine on a royalty basis of 5c. a ton, the farmer has received $193,600 above what he would have received by the 60 per cent. pillar-and-room method of working. This amounts to $193 per acre, or about twice as much as the farm value of the land. It should also be remembered that the expense of tipple erection, compressors and power plants and the general surface arrangement of a mine opened to develop a track of 1000 acres, is the same for 60 per cent. extraction as for 100.

It is said that in longwall working continuous operation is necessary, in order to properly control the roof, but a little consideration will show that this applies nearly, if not quite as well, to room-and-pillar work, particularly when the mine contains water. The statement of a certain large Western operator, a man who is both practical and theoretical, may be taken, *apropos* of this. He has recently changed a number of his mines to the longwall system, and during a strike lasting over a period of about five months and a half, all of his mines were shut down. On the resumption of operations he had careful records kept of the relative cost of opening the longwall and the room-and-pillar mines. These records showed the cost of opening the room-and-pillar mines to be nine times that of the longwall.

*See Twenty-second Annual Report, U. S. Geological Survey, page 178.

### Summary

Longwall mining provides an easier method of ventilation, a more thorough diffusion of explosive gases, a less quantity of timber, a ready disposal of refuse, and a certainty of no creeps or squeezes occurring to ruin the mine. In addition to this it has certain safety features, which should not be ignored, such as the impossibility of a general coal-dust explosion over an extensive area, since abandoned portions are practically closed and sealed off from the live workings, and the lessening of danger from a blownout shot, for, if rightly conducted, longwall requires little or no powder. The concentration of workings and the ease of superintendence should also be considered, for it is well known that in large mines there are portions in which the foreman seldom or never gets, while in longwall work this would not be true. Another item of considerable value is the large increase in the proportion of lump coal obtained, since longwall produces from 10 to 20 per cent. more lump than other methods.

When all the advantages of the longwall system are summed up, it seems remarkable that it has not been more generally adopted in the United States. That longwall will prove the ultimate and complete solution of all our troubles is not, of course, possible, but that it is the only method by which proper conservation of our coal resources can be obtained, seems to be beyond question. It is also thought that it will effect a material decrease in our death rate, but even if it only conserve our coal, it will prove its worth to the nation and the coal industry, and make the change a good one. The inverse ratio of price per acre with the number of acres left, will bring this idea more and more to the fore both in the minds of those who have to buy the coal lands and those who sell them.

## New Type of Coal Cutter

Special Correspondence

The advantages of machine mining over pick mining are well known and appreciated. In general it may be said that coal operators have long since recognized the superiority of mining-machine practice to bunglesome pick methods. New problems are, however, constantly arising in regard to the selection of the machine best adapted to certain kinds of work and in connection with the designing of machines for meeting new and untried conditions. The Jeffrey-O'Toole Coal Cutter was originally developed for the mines of The United States Coal & Coke Co. at Gary, W. Va. It is the result of a suggestion of Mr. E. O'Toole, general superintendent of that company, and the co-operation of Mr. O'Toole and the engineers of the Jeffrey Manufacturing Company.

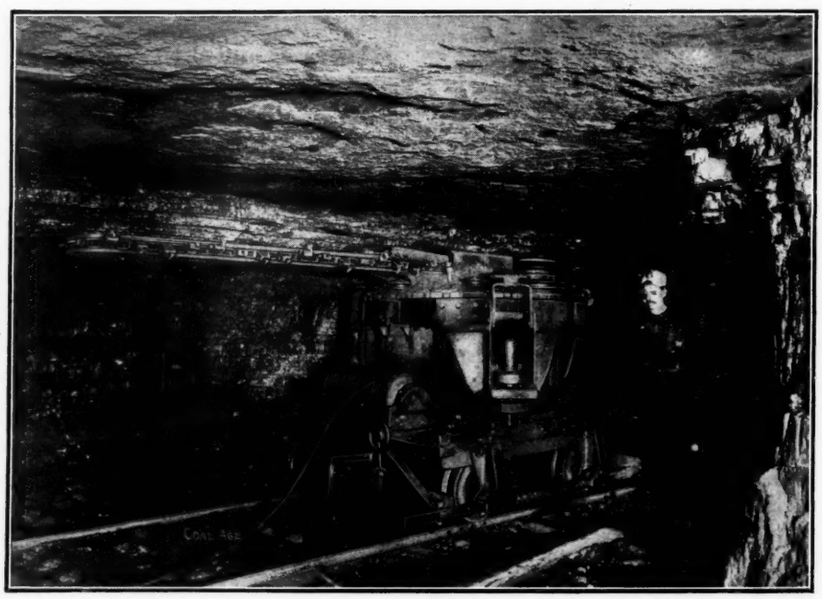


Fig. 1. Coal Cutter Ready to be Run to Another Place

### Cuts Seam at Various Heights

The machine is built to cut a kerf at various heights, depending upon the

thickness of the seam, and is particularly useful in cutting thick seams where the presence of dust or gas limits the amount of explosive which can be used for each shot. In such cases the seam is cut at about its center and a small charge is sufficient to bring down one-half at a time. When small bands of impurities occur in the coal, the cut may often be so directed as to remove them, permitting the coal to be taken out without becoming mixed with the dirt.

This coal cutter can readily be removed to another room after finishing a cut. When the coal face is narrow, much time and labor is often consumed in moving machines of other types to and from their cutting positions, loading them onto trucks, etc. With this machine it is only necessary to connect up the driving chain, release the jacks, and move it from the room under its own power. In the illustration, Fig. 1, the machine is seen in position ready for removal to another place.

The room track should, if possible, be placed in the center of room, but if this is not practical on account of the space required for refuse, the end of the track may be curved so as to bring the machine to the center of the room when up at the face. The machine is mounted on a self-propelling truck, and as soon as the truck chain drive is disconnected it is ready for work. The runner immediately starts the motor, and while the cutter arm is swinging over from its position parallel with the track to the point where it starts to cut, the helper sets the jacks.

The room face is cut in a semi-circle 18 ft. in diameter, and the machine advances 5 ft. for each cut. The cutter arm is provided with a rachet feed which may be varied by an arrangement that causes the engagement of one or more teeth per stroke of the operating eccentric. The total time required to feed the arm in a complete semi-circle is from 7 to 28 min., depending upon the rate of feed used. The fast feed is always used to bring the cutter arm up to the coal and from the coal back to the center position. At the beginning of a cut a higher feed can be used than at its central part, when the arm is fully under the coal. The machine operator can readily stop and start the feed by means of a disc friction clutch, which also acts as a safety slip in case the machine encounters material that it cannot cut.

### Construction and Operation

The construction and operation of the machine may be briefly described as follows:—The bed frame consists of a circular steel casting upon which is mounted the motor, all gearing and the cutter arm. This bed frame rests upon and revolves inside of a large steel ring, which forms the stationary frame. Riveted to this ring at three points, 120° apart, are cast-steel screw brackets, through which pass large adjusting screws. These screws are bolted to the steel top plate of the truck as shown in Fig. 2 and are fitted with adjusting nuts which are used to vary the height of the ring above the truck, and also serve to tilt the cutter-head to any desired angle.

The feed mechanism consists of a ratchet and lever operated by an eccentric on the main drive shaft. On the same shaft with the ratchet wheel is a worm which meshes with a worm wheel on the drum shaft. A disc friction clutch mounted on the drum shaft engages a rope drum, on which is wound a steel rope. One end of this rope is fastened to the hub of the drum and the other end hooked to the stationary steel ring.

Around the periphery of the circular bed plate are sheave wheels, over which the steel rope passes, and as the ratchet turns the worm, the drum revolves, winding up the cable and pulling the cutter-arm around in a circle. The disc friction clutch on the drum not only acts as a safety slip but allows a variation in the feed. As previously noted the ratchet is also arranged to engage one or more teeth at each stroke of the eccentric, thus permitting the feed to be varied at any time while the cutting is in progress.

The complete coal cutter is mounted permanently upon a steel truck which is provided with a self-propelling mechanism and an automatic reel for winding up and paying out the electric cable, as shown in Fig. 3. The machine can cut entries as well as rooms. When cutting entries, it is placed close to one rib and the cutter arm, starting in on the other rib, is sent under the coal until it cuts up to the rib by which the machine stands.

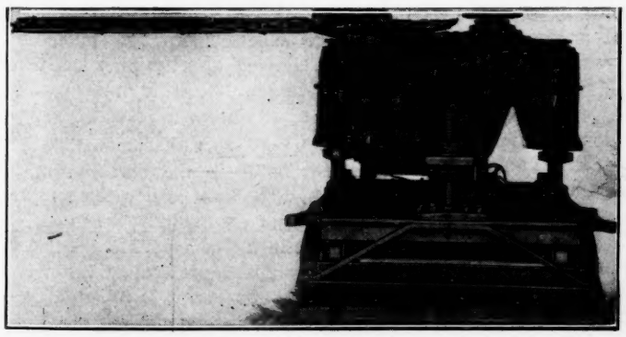


Fig. 2. Jeffrey-O'Toole Coal Cutter

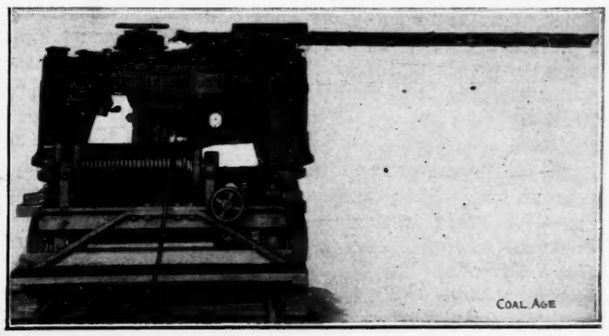



Fig. 3. Rear View, Showing Cable Reel

## The Peat Industry of Russia

In a recent report of the Baku naphtha industry there are given some interesting data concerning the exploitation, development and consumption of peat in the central industrial district of Russia. As the price of liquid fuel has risen beyond the limit at which its use is satisfactory to industrial concerns, the question of replacing naphtha with other combustibles has come prominently forward, and it appears that for a number of purposes peat is just the fuel required.

The peat industry has by now secured an unquestionably firm position. In 1908 there were 73 firms engaged in the production of this fuel and they put out that year a total of nearly 52,000,000 cu.ft. These operations are chiefly in the departments of Moscow, Waldimir, Nizhni-Novgorod, Rjasan, Kistroma and Tambow. In 1907, according to the superintendent of the Moscow mining district, the central industrial region of Russia produced 181,500 tons of peat. In 1908 the quantity delivered was equivalent to 544,500 tons of hard coal, and the number of men employed in the industry was 17,000.

It should be mentioned that the processes of peat cutting and preparation used in central Russia, include practically none of the improved methods which have recently been brought into use elsewhere, and there is a wide field for future improvement and development.

In regard to the extent of the deposits, it may be said that the present workings are estimated as being sufficient to supply all demands for at least 40 or 50 years. There are, moreover, in this district many bogs which have not as yet been touched.

# Ignition of Gas by Electric Lamps

Special Correspondence

**Tests of portable electric lamps made at the Frameries experimental station, Belgium, show that under certain conditions all electric-lamp filaments ignite firedamp. Composition of the gas, size, shape and nature of the filament, and voltage of the lamp are governing factors.**

NOTE—From *Annales des Mines de Belgique*. Article by Emanuel Lemaire, professor at University of Louvain and engineer, Frameries experimental station.

Portable electric lamps offer important advantages over ordinary safety lamps for lighting in gaseous mines. Their degree of safety is higher, since their luminous element has no communication with the mine air and therefore the danger of ignition does not increase with the proportion of methane and the speed of the air current. They have no delicate parts, such as metallic gauzes, which easily deteriorate and require careful daily inspection. They do not go out, and so the necessity of relighting inside the mine is avoided, a quality that is valuable in assisting the retreat of the miners after an explosion or mine fire.

They have, on the other hand, the disadvantage of being considerably heavier than ordinary safety lamps, and they do not indicate the presence of gas. However, this last inconvenience may be remedied by using at the same time a few ordinary safety lamps to serve as gas detectors.

An electric mine lamp well constructed, that is to say, strong without possible short circuits and one in which the sparks caused by opening and closing the circuit can only occur in an inclosed place, presents but one danger; that is, the breakage of the bulb. The existence of this danger, which may usually be remedied by surrounding the bulb with a protective envelop of thick glass isolating it from the surrounding atmosphere, has even been disputed, and contradictory opinions are offered on this subject.

We give in the present article the details of tests that have been made at the Government experiment station at Frameries, to clear up this point, to which the accident of July 7, 1905, at the colliery of Bois de La Haye, at Anderlues, had drawn particular attention.

### The Ignition of Combustible Gases by Incandescent Metal Wires

It has long been known that incandescent metal wires may ignite combustible gases and that the temperature to which they must be carried to produce this effect depends on their diameter and the nature of the gas.

Davy showed, in fact, that an iron wire, 1/40 of an inch in diameter, if brought to a cherry-red heat, ignited a jet of hydrogen escaping into the air but did not set fire to a jet of ethylene. The latter ignites on contact with wire of ⅛ in. diameter brought to the same temperature. An iron wire 1/500 in. thick does not ignite hydrogen at less than a white heat; at a dark red it ignites a jet of phosphureted hydrogen. At white heat a wire of 1/40 in. diameter does not ignite firedamp; at a red heat it ignites carbon monoxide.

On the other hand, experiments of M. Hauser, professor of the School of Mines at Madrid, on the ignition of gas by incandescent electric wires, have given the following results:

1. Ferronickel wires, 0.3 mm. (0.0118 in.) diameter, did not ignite the most sensitive mixtures of artificial firedamp whether the metal was fused or not.

2. With a platinum wire, 0.5 mm. (0.0197 in.) diameter, gradually heated to a red heat, the ignition of a mixture of 7 or 7.5 per cent. of natural firedamp was produced six times without a miss and without fusion of the wire, which burned brightly at the moment the explosion occurred. With platinum wires of 0.2 mm. (0.078 in.) diameter and natural firedamp, there were two ignitions in three tests.

3. With soft-iron wires of 0.9 mm. (0.035 in.) diameter, the results are particularly interesting. When using a straight wire placed horizontally or inclined, or a curved wire turned sometimes upward, sometimes downward, natural firedamp of 7.2 to 7.5 per cent. was ignited six times out of 17 trials, that is, in one-third of the cases. The wire did not melt when there was no ignition, but melted in the cases where this occurred.

### Influence of Shape of Filament

On the other hand, when using an inclined wire with a spiral in the middle, there were five ignitions in as many tests, and without fusion of the wire. In three of these tests the same wire was used three times successively and in a fourth test the twisted spiral wire ignited a mixture which had resisted a straight wire up to fusion.

4. As verification of the foregoing experiments, others were made with a steel wire of 0.6 mm. (0.0236 in.) diameter in pure artificial firedamp without obtaining an ignition in four tests where a straight horizontal wire 15 mm. (0.59 in.) long was employed, while ignition was produced by a wire 25 mm. (0.985 in.) long, incurved upward.

With an oblique wire coiled in three spirals, two trials were followed by explosions and in one of these cases the same gaseous mixture had already served three times successively for tests up to fusion of a straight horizontal wire 15 mm. long. This last experiment was repeated with the same result in natural firedamp.

It follows from these experiments by Professor Hauser that incurved wires or coiled wires ignite the firedamp more readily than straight ones, and that the susceptibility to ignition of gaseous mixtures is not the same with all metals.

Using iron wires of 0.05 to 0.35 mm. (0.00197 to 0.0138 in.) diameter, Messrs. Couriot and Meunier did not succeed in exploding firedamp mixed with air, even under conditions most favorable to explosion. Taken in connection with the foregoing experiments, these latter confirm the opinion that the finer the wires are the more difficult is it to produce ignition of explosive mixtures.

It is known that a combustible gas does not ignite in the presence of air unless brought to a certain temperature. In order that the ignition, when started at a point in the combustible gas and air mixture, shall be propagated throughout the bulk of the gas it is necessary that the heat liberated by the combustion of the first particles, which ignite in contact with the initial source of heat, shall be sufficient to raise to the temperature of ignition at least an equal mass of neighboring particles.

### Proportion of Combustible and Size of Wire

If the proportion of combustible gases in the mixture is small and less than 6 per cent. for mixtures of air and firedamp, the mixture simply burns in the immediate neighborhood of the source of heat, forming around this an aureole more or less well developed, but the heat liberated by this combustion is too small to bring the neighboring masses of gas to the required temperature, and the ignition is not propagated.

Certain facts, and notably the fact that fine incandescent wires less readily ig-

nite firedamp than those of larger diameter, tend to prove that even in an explosive mixture, it is necessary that a certain mass of combustible ignite at one time in order to propagate the ignition. If this mass of gas is too small, the heat freed by its combustion is dispersed too rapidly in the surrounding medium to bring the neighboring gases to the temperature of ignition.

The larger the wire and the higher its temperature, the larger the quantity which takes fire on contact with it. It may be inferred from this that wires of large diameter ignite explosive mixtures more readily than finer ones.

During safety-lamp tests in gaseous currents, a sharp, needle-like flame is sometimes seen coming out of a crack of the chimney without igniting the surrounding explosive mixture. It is necessary to assume that this flame communicates the fire to too small a quantity of the explosive mixture to propagate the explosion.

The fact that spirally coiled wires more readily ignite the firedamp than straight wires seems due to the circumstance that the mass of combustible gas which traverses the coil formed by the wire is heated on all sides by the filament and by the heat set free in the combustion produced on contact with the wire, and thus the gas may more easily be brought to the temperature of ignition.

The influence of the mass of the combustible materials fired at one time by the initial cause of ignition has already been placed in evidence by the study of dust explosions. Resting on what has been said, we may foresee the possibility of firing combustible gases by the finest wires if only their temperature be sufficiently high. However, certain substances are liable to melt before the necessary temperature has been reached.

The experiments made at the Frameries station on incandescent lamps have shown that this is true. In fact, it has been possible to ignite explosive mixtures of air and firedamp by means of the filaments of all the lamps tried, by sufficiently raising the temperature, although these filaments were only a few hundredths of a millimeter in diameter.

### Experiments with Carbon-filament Lamps

The experiments with carbon filaments were conducted with lamps of two and four volts. The bulbs, mounted on Sussmann lamps or connected to a battery of storage cells, with or without interposed resistance, and arranged to permit one or more elements to be put in circuit, were opened before their introduction into the test apparatus or else broken in the gaseous current itself by compression between the jaws of a vise. The experiments were made in gaseous currents of 0.5 to 10 m. per sec. velocity, containing 8 to 10 per cent. of methane.

The voltage and amperage were regulated on the lamp intact before the test; the voltage was measured at the contacts of the lamp, or, to speak more exactly, at the binding posts where were connected the large-diameter wires that brought the current to the lamp.

The electric current was cut off after each ignition of gas, to avoid the combustion or destruction of the filament during the time required for extinguishing the flames in the test apparatus; immediately afterward it was turned on again.

In a certain number of tests the temperature of the filament before rupture of the bulb was measured with a Féry absorption pyrometer. It is best to make some reservation on the subject of these temperature measurements, which were rendered difficult by the small size of the filaments with which experiments were made.

The experiments made by K. G. Falk in the laboratory of the Physico-Chemical Institute at Berlin and those at Columbia University, New York, have shown that the temperature of ignition of combustible mixtures varies with the composition of these mixtures. So it is that a mixture containing 50 per cent. of hydrogen and 50 per cent. of oxygen takes fire at 788 deg., while a mixture of 80 per cent. hydrogen and 20 per cent. oxygen ignites only on reaching 878 deg. A mixture of 66 per cent. carbon monoxide and 34 per cent. oxygen ignites at 875 deg., but a mixture of 50 per cent. carbon monoxide and 50 per cent. oxygen ignites only at 915 degrees.

For mixtures of air and gas, the experiments carried on at Frameries as a preliminary to the tests on the explosives, have shown that the compositions of greatest inflammability contained between 7.5 and 8 per cent. of methane. It is this composition which was used in the majority of the tests to which the carbon-filament lamps were submitted.

These tests have shown that it is possible to ignite explosive mixtures of air and firedamp by the incandescence of a carbon filament; numerous gas ignitions were obtained without rupture of the filament.

It is therefore learned that an incandescent carbon filament may ignite firedamp, and that this ignition is not necessarily produced by a spark resulting from rupture of the wire.

### Conditions Affecting the Experimental Results

Contrary to what might be supposed, the combustion of a carbon filament in air sometimes takes several minutes; the time necessary depends on the temperature to which it is brought, but this time is always appreciable.

The temperature to which the filament is normally submitted varies with the type of lamp; at least such was the case with the low-voltage lamps used for the experiments. Further, some lamps of the same type have a greater electric resistance than others and the temperatures of their filament may therefore differ for the same voltage applied to their binding posts. This is a primary cause of failure to obtain absolute agreement in the results.

There is also another cause of discrepancy. At the moment when the air enters the bulb, a cooling by convection is added to the cooling by radiation, and the temperature of the filament instantly falls. When we close the jaws of the vise slowly and carefully, the bulb is sometimes broken into only two or three pieces. In one test it was seen that these fragments, held by the jaws, remained so well in contact that the flame could not pass out. It may be inferred from this that in certain cases the exterior air may enter the bulb and lower the temperature of the filament before the cracks between the fragments are of sufficient size for the explosion to pass out. The manner in which the bulb breaks may, therefore, have an influence on the results.

The temperature of normal operation of the carbon-filament lamps for a consumption of 3.5 watts per candlepower is valued at about 1400 deg. by certain authors and about 1600 deg. by others. The U. S. Bureau of Standards fixes this temperature at 1800 or 1820 deg. C. These differences arise seemingly from the difficulties presented by high-temperature measurements in general, and especially in measuring the temperatures of incandescent filaments.

### Temperature of Filament and Rapidity of Gas Ignition

When a bulb is broken in a gaseous medium, or when the current is passed through the filament of a lamp broken in advance, we obtain:

1. Combustion of the filament without ignition of the gas.
2. A retarded ignition, which sometimes takes place after several seconds without the wire necessarily having been ruptured.
3. An immediate ignition.

After a series of immediate ignitions, there are sometimes produced one or more retarded ignitions; sometimes also the filament burns up without lighting the gas. On the other hand, the retarded ignitions are sometimes followed by immediate, or less retarded ones.

The tests on bulbs opened before introduction into the testing apparatus show that by greatly overvolting the lamps we get immediate ignitions; by overvolting them less, we get retarded ignitions, and by not overvolting them at all, or by letting them fall below the normal voltage, the filament more often than otherwise breaks without lighting the gas.

The immediate ignitions require high temperatures of the filament for their production. For lower temperatures the filament burns without lighting the gas, or produces retarded ignitions.

When breaking the bulbs in the testing apparatus itself, we obtain immediate ignitions with lamps working at their normal voltage. The same temperature of the filament may evidently be produced by a weaker current when the filament is in vacuum than when it is in the air.

The minimum temperature necessary to obtain these ignitions is about 2050 deg. C. The majority of the four-volt lamps tested work normally at temperatures above this latter; those whose filaments have a lower temperature, have a weak lighting power, and their consumption of energy per unit of luminous effect is excessive.

It has often happened that when the bulbs were broken in the testing apparatus itself, retarded ignitions were obtained for temperatures very much above 2050 deg., but there is room for believing that the manner in which the bulb was broken influenced these results. As has been explained above, it seems reasonable that the temperature of the wire decreased before the ignition was able to pass to the outside through the cracks between the fragments of the broken bulb. To avoid too frequent breakages of the filament by fall of the pieces of glass when the bulb broke, we coated the jaws of the vise with a cement, so as to hold the fragments. This explains the ease with which they could be held in contact.

### Influence of Resistance in the Circuit

The retarded ignitions seem due, in part at least, to the influence of the electrical resistance of the circuit on which the bulbs were connected.

This resistance is composed of:

1. The interior resistance of the battery of storage cells.
2. The resistance of the conductors.
3. The resistance interposed, in the majority of tests, to regulate the difference of potential at the contacts of the lamp.

The electromotive force absorbed in these resistances decreases when the intensity of the current lessens, and this falling off of intensity occurs in the course of the tests when the combustion of the filament reduces its diameter and increases its resistance. During the tests, the difference of potential at the binding posts of the filament therefore increases proportionally as the electromotive force absorbed in the external resistance diminishes, and from this may result an elevation of the temperature of the reduced wire. By observing with a pyrometer the combustion of a filament put in circuit with a resistance, we note that its temperature consistently increases, which is not observed when the tension at the binding posts of the lamp is constant.

It seems, therefore, that the resistance of the exterior circuit of the lamp must be, at least in part, the cause of the retarded ignitions. The temperature of the filament, which is too low at the beginning of the test to ignite the explosive mixture, gradually increases up to the point of ignition and may then cause immediate or less retarded ignitions.

When the filament has been much reduced by a series of successive incandescences, the difference of potential at the binding posts of the lamp differs little from the electromotive force of the battery. The filament then behaves as if the difference of potential at the binding posts of the lamp were constant; its temperature decreases at each incandescence and finally it burns up without lighting the gas.

The experiments made on lamps opened before introduction into the testing apparatus, show that in order to light the firedamp when the speed of the gaseous current is increased it is necessary to increase the superpressure on the lamps. This result, due to the greater cooling undergone by the filament in high-speed currents, could have been predicted in advance.

### Experiments with Metallic-filament Lamps

We know that the illuminating power and the efficiency of incandescent lamps rapidly increase with the temperature to which the filament is carried. Taking as a unit the brilliancy of platinum at its fusing temperature, M. Violle found the following relations between the luminous intensities at the various temperatures:

| Temperatures | Relative Intensities |
|---|---|
| 775 deg. | 0.00007 |
| 956 deg. | 0.00120 |
| 1035 deg. | 0.00450 |
| 1500 deg. | 0.27100 |
| 1775 deg. | 1.00000 |

For temperatures above that which corresponds to a consumption of 3.5 watts per candlepower, the carbon-filament lamps are quickly burned out. To improve the efficiency of the lamps, it is necessary to resort to certain refractory metals, such as tungsten, tantalum, iridium, osmium, zirconium, etc., filaments of which can stand higher temperatures without too rapid injury.

Osmium melts only at about 2500 deg., tantalum between 2250 and 2300, iridium at 1900, according to Violle, and between 2200 and 2300 according to Weyle. The temperature of fusion of tungsten is about 3080 deg., according to Burgess and Waidner, and of tantalum, 2910 degrees.

The metallic-filament lamps normally run at very high temperatures. According to the U. S. Bureau of Standards, the working temperature for tantalum lamps is 2000 deg., and that of tungsten lamps 2300 degrees.

By reason of the high temperature of their filaments, it might have been predicted from the start that these lamps would be more dangerous as regards ignition of gas than carbon-filament lamps. All the metallic-filament lamps experimented with have lighted the gas at their normal working temperature, and even at lower temperatures.

In a certain number of cases, several consecutive ignitions were obtained with the same filament, which shows that it is indeed the incandescence, and not only the spark of rupture, which causes the explosion. One filament, notably, gave 14 consecutive ignitions before breaking. In the cases where only one ignition was obtained, it was often noted that a current continued to circulate in the filament after the explosion of the gas, which shows that it was not interrupted. Certain metallic filaments have lighted firedamp at temperatures which with carbon-filament lamps present no danger.

### Conclusions

It follows from these tests taken all together that the rupture of the bulb of an electric mine lamp with carbon or metallic filament must be regarded as dangerous in a gaseous atmosphere.

It is possible to manufacture lamps whose filaments will not reach a dangerous temperature, but the lighting power of these lamps will probably be very feeble, and the consumption of power per unit of light excessive.

By reason of the importance of this question of good underground lighting, it is preferable not to follow this method, but rather to seek to obtain electric mine lamps of high lighting power by raising the temperature of the filament up to the limit consistent with the required degree of durability. Under these conditions magnificent lighting powers may be obtained, but in order to get them it is necessary that the storage battery shall deliver during a working shift a current of 1.5 amp. at two volts, or better a current of 1 amp. at four volts.

And it is then absolutely necessary to guard against the danger resulting from a breakage of the bulb, by surrounding this with a thick and strong glass envelop with hermetically sealed joints.

# Permanent Roof Sustention

By R. Dawson Hall

**The blasting of rock causes it to occupy increased space. This property is utilized to provide support for the roof, chamber filling for miners to work on, and dams for culm flushing.**

William Griffith, one of the distinguished engineers appointed by the Scranton Mine Cave Commission to investigate on its behalf the inadequate support of the city by the pillars of the coal mines thereunder, has filed two patents, Nos. 1,004,418 and 1,004,419. The first of these covers, among other matters, one of the recommendations embodied in his report to the city. That report advocated the method of filling up the workings by the blasting of the roof and floor. The greater volume occupied by the blasted rock is relied on to fill the place vacated by both rock and coal, and to support the roof.

### Mine Cave Commission

To quote the words of Messrs. Griffith and Conner in their report: "It is a well known fact that loose rock occupies from 1⅓ to twice the volume of the same weight of rock in place. In other words, if a cubic yard of bed rock be broken to pieces, it will occupy a space of 1⅓ to 2 cu.yd. Your engineers have conceived the idea of taking advantage of this fact, well known to engineers, for the purpose of cheaply producing an adequate support of the rock and surface above certain classes of coal beds under the city of Scranton. So far as we know, this method, in its entirety, has never been used before in any coal-mining district, and the suggestion is here made for the first time.

"The process is applicable to beds less than 6 ft. in thickness, and so located that the shock in heavy blasting will not produce ruptures of the measures supporting adjacent coalbeds. It consists simply in blowing up the floor and shooting down the roof of the mine, each to a depth equal to the thickness of the coal bed. This produces a total thickness of loose rock equal to three times the thickness of the coal. The rock would be well packed together and have great supporting power, and moreover the desired ends would be attained in a comparatively inexpensive manner.

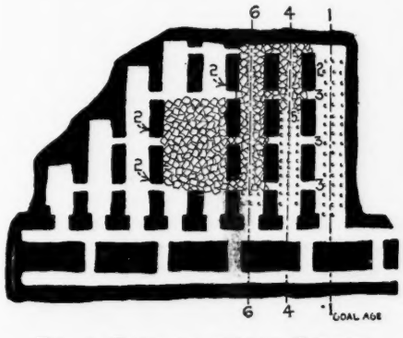



Fig. 1. Room-and-pillar Filling

"This method might be adopted throughout the Dunmore seams, by blasting down the roof and lifting the floor in the abandoned rooms or in the roadways between the gob piles in the chambers. Wherever it is applied efforts should be made to fill completely the whole width of the chamber or roadway from wall to wall, so that the loose rock may be confined between the pillars, thus greatly increasing the resistance to compression."

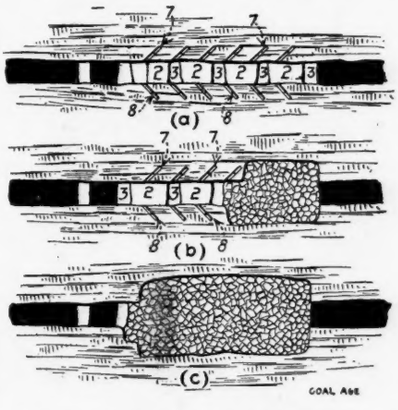



Fig. 2. Vertical Sections of Fig. 1.

### Strength of Broken Rock

The following table taken from the same report gives a marked illustration of the value of rock fills for roof support. The measure of strength on which it is based is the number of feet of coal-measure rock necessary to compress the roof supports described, to the percentage of their height given at the head of the columns.

Thus a loose pile of broken sandstone of such size that all the material of which it is composed will pass through a 1¾-in. ring, and containing voids aggregating 40 per cent. of the whole mass and moreover without aid from lateral confinement, will shrink 5 per cent. when loaded with 20 ft. of rock, and 30 per cent. when loaded with 298 ft. of the same.

### Rock Blasting in Level Measures

The method of operating under this plan is illustrated in five cuts. Fig. 1 shows a plan of a regular room-and-pillar working where the pitch of the measures is gentle. The room on the right is typical of the average anthracite workings. Fig. 2 (*a*) shows a vertical section along 1-1. In both plan and section, 2 represents the pillars between the crosscuts 3. Fig. 2 (*b*) shows a vertical section along 4-4. From 5 to the end of the room, the proposed method of roof support has been adopted and the whole space has been filled with the débris. In Fig. 2 (*c*) is seen a vertical section 6-6 of the third chamber, the shooting of the top and bottom having reached a further stage. The holes marked 7 in the roof and 8 in the floor are bore holes prepared for the blowing of the roof and of

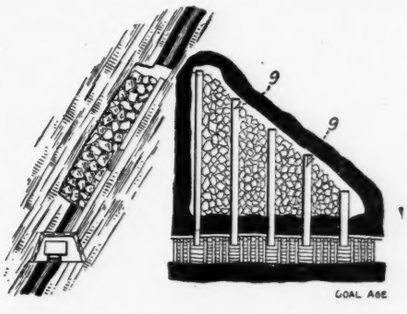



Fig. 3. Filled Longwall Working

SUPPORTING STRENGTH OF BROKEN SANDROCK OR SANDSTONE

Loosely Piled

| Material | Voids | Percentages of Shrinkage 1 | 3 | 5 | 10 | 20 | 23 | 27 | 30 |
|---|---|---|---|---|---|---|---|---|---|
| Sandstone passed through 1¾-in. ring | 40 per cent. | .. | .. | 20 | 53 | 124 | .... | ... | 298 |
| Sandstone voids filled with sand | 40 per cent. | .. | .. | 21 | 53 | 186 | .... | ... | 465 |
| Large-size sandrock | 45 per cent. | .. | .. | 45 | 66 | 121 | .... | ... | 492 |
| **With Lateral Confinement** | | | | | | | | | |
| Large sandrock | 50 per cent. | 12 | 27 | 45 | 117 | 434 | .... | 715 | .... |
| Sandstone | 40 per cent. | .. | 44 | 74 | 177 | 680 | .... | ... | 3315 |
| Sandstone with voids filled with dry sand | 40 per cent. | .. | 46 | 77 | 325 | 4100 | 8860 | ... | .... |

the floor. The proposals of the inventor are to use this method for different purposes, either on "first" mining to permit complete extraction at one operation or after first mining to provide for the robbing of pillars left in. It is also claimed that the roof will be upheld by the broken rock at all times, so that the surface will have a minimum subsidence. The intention is to use the rock where it is blasted. Mr. Griffith prefers to blow the holes in roof and floor alternately, apparently with the idea of breaking the rock more completely and in order that the rock in falling may fall on an uneven surface and roll over in a manner conducive to the creation of large interstitial spaces. The bore holes being inclined at 45 degrees to the strata, the roof rock will be shattered so that the same purpose of volumetric increase will be assured by that means also.

Mr. Griffith proposes either to fill the workings with broken rock while advancing in long wall or to fill alternate rooms in room-and-pillar workings and to extract from the unfilled rooms the pillars on either side of the same. These unsupported rooms and extracted pillar spaces can be subjected on the retreat to like treatment, the floor and top being blasted as the pillars are removed.

The inventor points out that the method is adapted to old workings as an assistance to pillars left in first mining or as a means of withdrawing those pillars.

### Rock Blasting for Support of Miners at Face

Fig. 3 also illustrates the first patent, but contemplates a somewhat different method of mining. The right half of the figure shows the plan of a longwall advancing method in steep measures intended to be pursued only for one panel at a time. From a gangway, a number of openings are driven up the pitch till a sufficient pillar is left to protect the heading. Then the openings are widened out, as is shown, so that no pillars remain between the various openings. To keep the passageway open for the miners and the coal, a chute is built of timber, metal or other desirable material. The miners can enter by any of these chutes. The coal is shown as having a slate split between upper and lower benches. This layer can be taken out and thrown back. If it proves unequal to filling the space behind, the roof is to be blown down, filling the whole area in such manner that complete sustention is assured. On this platform of rock the miner can work without difficulty.

### Blasting with Flushing

The second patent No. 1,004,419 contemplates a change in the old-time culm or sand-flushing methods. In Fig. 4 (*a*) are shown three rooms from which the pillars and heading stump pillars are removed. Within the space thus left unsupported, the roof and floor are shot in a roughly circular ring, the shooting being regulated so that the blasted rock will make a complete circular wall, filling not only the place where the coal was excavated, but the space from which the rock itself was blasted. This blasted rock is expected to fall in such manner that it will key itself firmly and resist extrusion. A section 2-2 taken through the chamber is shown in Fig. 4 (*b*). It will be seen how the rock 1 fills the blasted

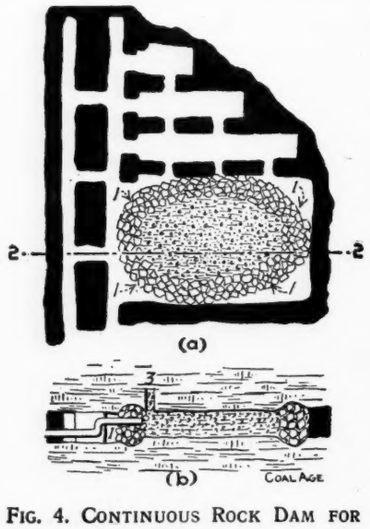



Fig. 4. Continuous Rock Dam for Flushing

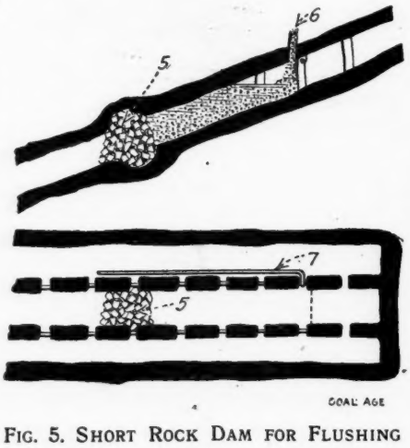



Fig. 5. Short Rock Dam for Flushing

notch both in roof and floor. By a bore hole 3 from the surface, or by a pipe arranged to pass through the rock ring 1, culm or sand is flushed in by the force of water. The water escapes through the surrounding rock and is removed from the mine by pumps. This culm or sand will serve to aid the rock in sustaining the roof. It will then be possible to rely on this artificial pillar and to remove adjacent pillars. The coal pillars thus removed can be replaced by the erection of another artificial pillar like that just described. Fig. 5 is a plan of a heavily pitching chamber with the usual crosscuts on either side. Mr. Griffith proposes to blast a dam 5 by shots in the roof and floor and then by means of a bore hole 6 leading to the surface, or by a pipe 7 passing through a brattice, to flush culm or sand or other material till the chamber is filled, the lateral movement of the filling being resisted by the brattices, as in the case of the foregoing patent. The artificial pillars thus created can be used for maintaining the roof in abandoned workings or during second mining, where merely the sustention of the surface is sought or it may be used in first mining to aid in a final recovery of the coal.

The systems by Mr. Griffith appear a notable addition to the present practice of mining. The need for an increase in the practice of "flushing" or "slushing" or for a system replacing it is keenly felt. The time is passing when it can be confidently asserted that the value of the pillars is less than the cost of their recovery by approved methods.

## Italy's Coal Trade

Italy mines annually about 500,000 metric tons of lignite and imports each year 10,000,000 metric tons of various kinds of coal, according to Vice-Consul Alden March, who writes from Leghorn in the province of Tuscany. The United Kingdom practically controls these imports. Cheap freight rates and the opportunity to take home return cargoes count heavily in favor of the British mine operators.

The industrial development of Italy will demand annually greater quantities of coal. In many localities the wood supply for domestic purposes is growing smaller, and the more general introduction of coal stoves makes for a larger consumption of anthracite. These conditions would seem to warrant the serious consideration of American coal men.

In the Leghorn district there is an increasing demand for all kinds of coal. It is used for railways, manufactories, smelters, and to supply household demands. The province of Tuscany, of which Leghorn is the port of entry, consumes annually about 100,000 tons of domestic lignite, 300,000 tons of Cardiff steam coal, 100,000 tons of North Country and Scotch coal, 120,000 tons of Newcastle gas coal, and 50,000 tons of Westphalian coal, to which may be added about 10,000 tons of so called patent fuel. No coal is at present imported from the United States.

Sometimes a good way to promote the market for a given kind of coal is to conduct a campaign of education on the proper way to use it.

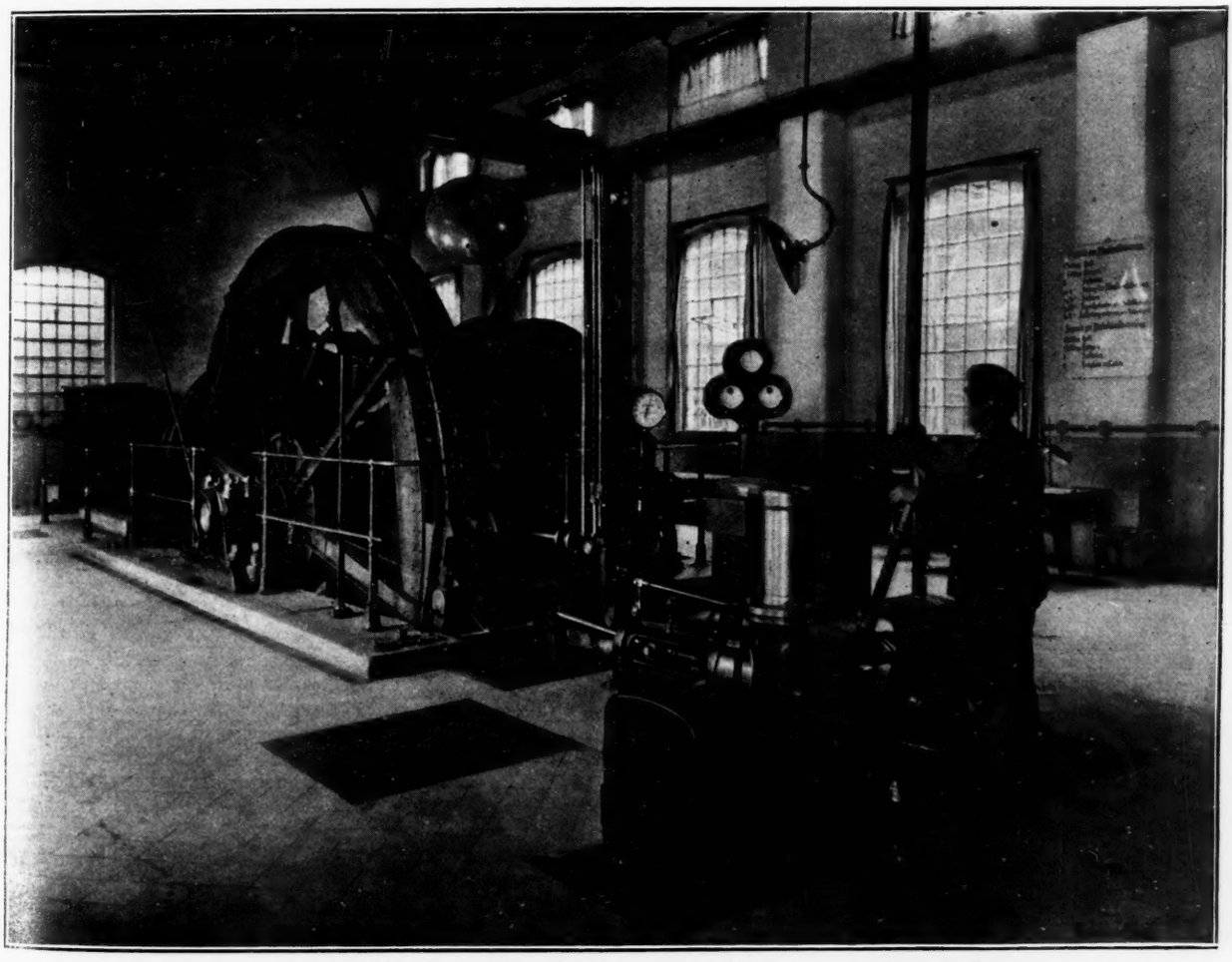
# Coal Situation in Germany, 1911

By O. H. Hahn*

**The state railroads furnished an inadequate car supply while drouth in rivers made demand for rail transportation heavy. Silesian coal is being replaced in foreign markets by British. Government admits its error in purchase of Stockheim colliery. Sixty-five million tons of lignite mined.**

*Schillerstrasse 6, Jena, Germany.

During the year just past, the regular production and disposal of coal has been greatly hampered, owing to the inadequate supply of rolling stock furnished by the state railways for the transportation of the product of the collieries and iron works. The situation was aggravated still more by the uncommon drouth which put a stop to navigation on rivers and canals for a period of two and, in some cases, three months, whereby additional freight was thrown on the hands of the railroads. The newspapers of the industrial districts published daily lists of cars ordered and furnished, which must have been unpleasant reading to the government officials. Thus, for instance, in Upper Silesia during 14 days in October, out of 43,108 cars demanded per working day, there was a shortage of 3079 cars. At Essen, Rhenish Prussia, of 29,201 cars ordered there was a shortage of 6145, and so forth. The effects of such a state of affairs are manifold and distressing. The surplus output of mines, briquet factories, etc., has to be stored in the yard or outside, which causes extra expense and injury to the quality of the material by weathering. When the limit of space is reached, the output has to be curtailed, and this only can be done by putting the workmen on half time or by laying them off altogether. This means diminished earnings for them, and this is especially hard at the present time, when all commodities of life have gone up in price. Discontent of the workmen will lead to strikes, and signs of unrest have been apparent for some time in the Ruhr district, one of the busiest in the country. As general expense, maintenance of plant, etc., will remain the same, the cost of the products will, of course, become higher. Consumers will also suffer by not being able to rely on their orders being filled. Nevertheless, in the face of these adverse circumstances, the production of coal in 1911 has kept up to the figure of 1910, viz., 150 million tons.



INTERIOR OF HOIST HOUSE, SHOWING MAIN-PIT WINDING MACHINE AT A GERMAN COLLIERY

### INDEPENDENT COKE PRODUCERS SUFFER

Coke is rather a drug in the market at all so called "reine Zechen," which are collieries not connected with iron works. The "Hüttenzechen," or furnace-owned collieries, are competing with the "reine Zechen" in the disposal of their surplus coke. Through lack of shipping facilities the "reine Zechen" have not been able to ship much of their coke abroad. It is true there is a pool, the Rhenish-Westphalian coal syndicate, composed of

"Hüttenzechen" to regulate and maintain prices, but the "reine Zechen" would fare badly in joining that organization, as their quota of production would be set as low as possible by the pool.

So it is fortunate that some of the by-products made by the coke-producing collieries find a ready market. Thus, there is an ever-growing demand for sulphate of ammonia, while tar, benzol, naphthalene, solvent naphtha, toluol, etc., also sell briskly at times. Moreover, gas is often sold for power. The byproducts of the Rhenish-Westphalian district are disposed of by a joint selling agency at Bochum, which is called the "Deutsche Ammoniak-Verkaufsvereinigung." The prices are made up on the basis of the London quotations.

Silesian industry, especially the Upper Silesian collieries, are clamoring more than ever, and with good reason, for a reduction of railroad rates to reconquer the Berlin market for coal, which they have lost to Great Britain.

### Misplaced Investments

The kingdom of Bavaria, which is not rich in mineral treasures, especially not in coal, has suffered a serious financial loss in the collapse of its Stockheim colliery. It was purchased by the state from private parties only 2 or 3 years ago for 2½ million marks ($595,000) on the representation that it had a reserve of 5 million tons of good coking coal. After putting up a costly coal-cleaning works and on opening up the mine on a large scale, it was found that the coal was almost worthless. To cut off the recurrent losses the mine was finally shut down, and the government had to make a clean breast of its mistake to the Diet; not a pleasant duty by any means. Besides it had to find employment for the people depending on the mine work for their living.

In Westphalia, the "Stolberger Aktien Gesellschaft" was obliged to close its Lukas colliery, after having spent several years of labor and several million marks in money on opening it. The reasons for so doing have not been made public.

### Lignite Tonnage is Large

Germany has an abundant supply of lignite in its tertiary formation. There are 18 distinct districts, foremost of which in production is the Thuringian-Saxonian, with an output of 25 million tons. Then follow the Lower Rhenish and the Lower Lusatian with an equal output of 15 million tons. All told, 481 mines yield about 65 million tons. A large portion of the lignite is briquetted, for in this shape it is better suited to household use. In industrial establishments, where the mine-run coal is used, step-grates are required for burning it. The lignite mines are frequently owned by or connected with beet-sugar factories, cement factories, brickyards, etc. One of the largest lignite mines is the "Marga," owned by the Ilse Brown Coal M. Co., in Upper Lusatia. It is equipped with 36 briquet presses and the largest steam shovel in Europe, if not anywhere. The sale of briquets is also controlled by selling agencies, in order to prevent demoralization of the markets. The lignite producers have to compete with their Bohemian colleagues to a certain extent, as the latter have cheaper labor and river navigation in their favor. The new law passed by the Reichstag, which authorizes the levying of river toll by the government, may destroy this competition.

# Electric Transmission in Coal Mines

By Henry D. Jackson *

**The transmission system is frequently a neglected part of the electrical equipment in coal mines. Its proper installation and maintenance are, however, most important factors in reducing the cost of power and securing the operation of electrical apparatus against undue expense for repairs.**

*Associated with T. W. Sprague and F. H. Keyes, as consulting engineers, 88 Broad St., Boston, Mass.

Within the past few years the use of electricity in coal mining has increased rapidly, particularly the introduction of alternating-current generating and distributing systems. These usually deliver high-voltage alternating current to substations where it is transformed to direct current for use in and about the mines.

Direct-current generation and distribution have been in use for some time, and have proved in many respects far more satisfactory than compressed air and other forms of power. In many cases they have operated to displace both mules and compressed air as means for hauling coal cars over long distances, although mules are still in general use for bringing the cars from the rooms to the entries or to the electric-haulage system. In gaseous mines, mules and compressed air are still largely employed, but even in this field the gradual displacement of both seems probable as a result of the development of the storage-battery locomotive, which has all its parts carefully inclosed, the controllers operating under oil.

It is a curious fact that in many mines operating by means of direct current, the distribution system is frequently neglected to a far greater extent than is warranted by the conditions. As a rule the stations are fairly well kept up and operated with average economy. The locomotives are kept in fair condition considering the work they have to do and the labor that is employed to operate them; but the transmission system, by which is meant the wires or cables carrying current to the motors and the track or return circuit carrying current back to the station, is often kept in bad shape. So far as I have been able to ascertain, the reason for this is the illogical assumption that, owing to the fact that coal costs the mining operator but little, the power cost is proportionately low. The coal should be charged up to the power plant at a price equivalent to that for which it might be sold, unless it happens, as it does in some cases, that the coal used is the culm pile, under which conditions it would naturally be considered as having no value beyond the cost of taking it from the mine and delivering it to the bunkers.

### True Cost of Electric Power

Under most conditions, coal operators seem to consider that the cost of electricity as delivered to the machines or to the line, is the plant operating cost only, that is to say, the cost of the labor, oil, water, coal, and possibly the maintenance charges. This, however, is not true. The cost of power should take into account the interest, depreciation, etc., on the power plant, and in many cases an allowance for pretty heavy taxes. The cost of power plants in the coal regions is not low, owing, among other reasons, to the fact that in many cases the plants are so located as to involve a considerable charge for the delivery and erection of machinery, so that the interest charges are heavy, the repair charges equally heavy, and the total cost of power is greatly in excess of the operating charges alone.

Economical use of the power generated is therefore necessary to reduce to a minimum the size of the units which may be required for such power generation, or, in other words, to secure the operation of the largest possible number of locomotives and other apparatus with the minimum power output. This can be done only by keeping the transmission system always working at an efficient point; by doing away with excessive transmission losses

due to the use of small feeders, leakage losses due to poor installation and losses in the return circuit through poor bonding and restricted area of the return feeders.

Besides the waste of power, another feature of excessive losses on the transmission line, which is equally bad from the operating standpoint, is the consequent increased heating of the motors and the reduction in the speed or power of the locomotives which results in a marked decrease in their hauling capacity or in the amount of coal that can be handled by a stated number of locomotives. It is a fact that for the best results as regards economy of distribution, the interest and maintenance cost of the copper and the return circuit should be equal to the cost of power lost over them during the year. If the lost-power cost is greater than the interest and maintenance, the circuit is too small; if it is less, the copper is too large. This is true, however, solely from the financial and theoretical standpoints. There are other considerations than these. In a small plant, it is impossible to put in a small enough amount of copper to fulfill the above condition, because such an amount would not allow the operation of the locomotives at all; and in a large plant, the amount of copper called for would be far too small. So, this condition is a point to be taken into account but should be supplemented by considerations which are necessary to insure that the motors will get sufficient power for their operation and will be enabled to work at their full capacity without excessive heating and repairs.

### Calculation of Copper Required

In installing the copper for a transmission system, it is advisable to make some calculation as to the probable load that will be brought upon the system, and locate the approximate center of the load. Then, on the principle that the voltage at this center of distribution should not drop below a point at which the motors will operate satisfactorily with the maximum current on the line, the total resistance of the line should be determined from the formula

$$R = \frac{E}{C}$$

where

$R$ represents the resistance;

$C$ represents the current;

$E$ represents the electromotive force.

Then $E$ will represent the electromotive force lost over the wires or the total drop in the circuit. Knowing the dimensions of the rails, the resistance of these can readily be calculated by figuring that each pound of rail per yard is equal to 9000 circular mills of copper. Then, knowing the length of the rails, their total resistance can be figured, and the difference between this amount and the value of $R$ as calculated by the above formula, will represent the resistance which may be allowed for the overhead conductor. If it turns out that it is more expensive to install copper overhead than it is to add it to the return circuit, additional copper may be used for the return, and a smaller amount used overhead. After this copper has been figured, and laid out, it can, of course, be distributed so that it covers the entire line to be electrified, using a heavy section up to a point at about the center of the load and from there on, reducing its size at intervals, in accordance with the length of the line, until finally the trolley wire alone is carried to the extreme end.

Having laid out the copper in this way, a load curve should be approximated, showing as nearly as can be the actual amount of power used from time to time throughout the day, and, if possible, the average for the year. As a matter of fact, the average is not the best figure to use, because the power lost over the wires is equal to the current squared, times the resistance, and the discrepancy will be considerable between the calculated and actual drop in voltage during a period of overload, but for all practical purposes, if the average is multiplied by $1\frac{1}{10}$, this figure will give near enough to the figure required for determining the loss. By multiplying the total resistance of the circuit by the square of $1\frac{1}{10}$ times the average current and by the total number of hours in which it is used during the year, the power lost for the year may be calculated. If by adding additional copper this loss can be reduced to such a figure that the cost of the wasted power will more than pay for the interest on the additional copper required, this copper should be installed as an evident economy.

### Rail Bonding

On the return circuit, rail bonds are necessarily used in order to secure a good electrical circuit. These bonds are a continual source of trouble, frequently giving out and resulting in a high resistance on the return circuit. They should always be kept in good condition. It costs but little to keep them so, and the loss due to a single bond when in bad shape is equal in a year to many times the cost of the bond itself; moreover, the operation of the haulage road is otherwise materially affected. A good transmission system, properly designed and worked out so that its losses are kept low, will result in:

1. A decided reduction in the amount of power required to be generated.
2. A low cost of power distribution.
3. A considerable increase in the amount of coal that can be handled.
4. A marked reduction in the motor repairs, both for the locomotives and the cutting machinery, because of the smaller current required for their operation, owing to the higher voltage.

These are points well worth considering, and the transmission system is an item worthy of far greater attention than it now receives.

## Electrically Operated West Virginia Mines

By F. C. Perkins*

Electric locomotives as well as electrically driven pumps and ventilators are used extensively at the mines of the Davis Coal and Coke Company in West Virginia. This company owns 160,000 acres of coal land and operates mines, along the lines of the Western Maryland Railroad, at West Virginia Central junction, Elk Garden, Harrison Henry, Coketon, Weaver and Thomas.

At Thomas, W. Va., the Upper Freeport coal is mined by drifts at tipple height above the railroad. Mine No. 23 has been operated for a number of years and has extensive workings but is still a good mine, producing 1200 tons of coal per day from a seam 8½ ft. thick and free from noxious gases. Mine No. 25 is directly opposite with a drift opening slightly to the dip in the same seam of coal, and mine No. 24 is worked by a shaft 20 ft. deep penetrating to the Davis seam of the Lower Kittanning. This group of mines is operated entirely by electric haulage and other electrically driven equipment.

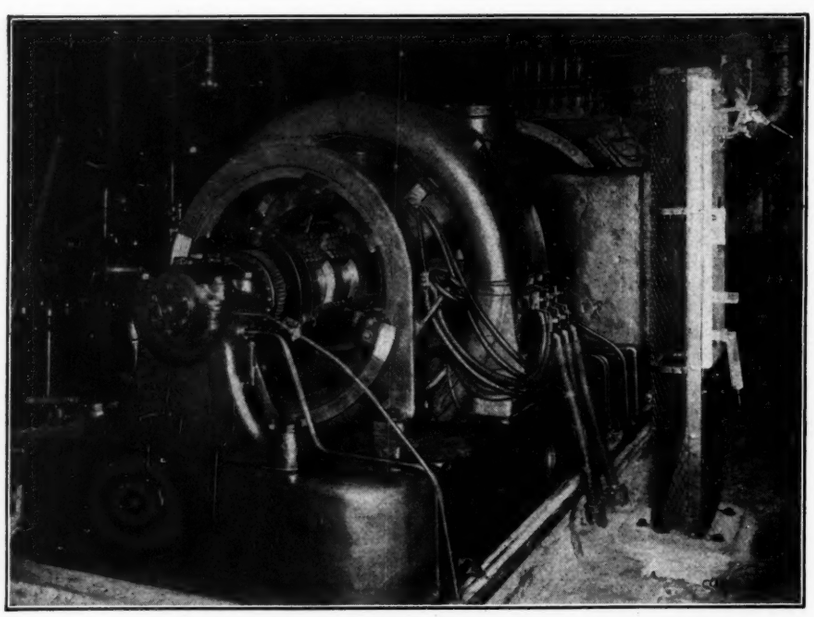
There are also 114 coke ovens at this plant served by electrically operated coke larries of the General Electric type. The results obtained with these larries, which run along the top of the ovens where the heat is at times excessive, and where the fumes would be injurious to horses or mules, have been excellent. It has been found also that they are much quicker in operation than the animal-propelled variety because the control is so perfect that when about to discharge into the oven they can be moved backward or forward an inch at a time. They are used either independently or with trailers, and offer a flexibility not otherwise obtainable.

While the operation of the electrically equipped larries has always been all that could be desired, more or less trouble was experienced from time to time with the haulage locomotives, as the workings in these mines became more and more extensive, the length of hauls greater, and some steep grades necessary. To remedy this condition the capacity of the trolley lines and feeders was increased by the addition of copper in order to reduce the drop in voltage which took place when heavy loads were started up at the working face, the track bonding was thoroughly overhauled, and the rails put in condition.

*Buffalo, New York.

### The Turbo-generator

However, it was only upon the installation of the 500-kw., 600-volt, direct-current steam turbo-generator shown in the illustration, that these troubles entirely disappeared. The turbine is of the Curtis horizontal, high pressure type, operates at a speed of 1800 r.p.m. and is directly coupled to a four-pole General Electric dynamo. It is considered to have demonstrated the particular suitability of this type of prime mover for handling the enormous fluctuations in load which occur in mining work. The normal current of this machine at full load is 833 amp. but the unit is continually called upon to handle loads varying from practically 0 to 1450 amp. and these variations recur, sometimes at intervals of a minute or less; for example when a train is picking up cars at the far end of the mine. This installation possesses the steadiness required to stand up under these severe conditions and there has resulted the entire disappearance of the formally frequent burn-outs of motor armatures, etc.



Direct-current Turbo-generator Set, Thomas Mines

The 500 kw. turbine generator provides current for one 20-ton and eight 13-ton electric locomotives and for the coke-oven larries.

Direct-current series motors were adopted at this mine for haulage and hoisting purposes because of their characteristically high torque at starting, and it was decided to generate power at a potential of 600 volts owing to the long distances to which it had to be transmitted. It is maintained that the objection of increased danger to men and animals, where the latter are still used for gathering purposes, which might be raised against this high potential is more imaginary than real because of the fact that the current is turned off while the shifts are changing and, as a matter of fact, there has been no loss of human life from electric shocks in the company's entire history.

While 600-volt direct current is used for haulage in all of the various workings, three-phase alternating current is employed for practically all other purposes around the mine. For street lighting, single-phase alternating current, derived from constant-current tub transformers, is used. The power plant is equipped with two 100-kw. three-phase 60-cycle alternators, for operating the tipple machinery and the pumps. There are three of the latter in use, one having a 3-in. suction and 2½-in. discharge, one a 6-in. suction and 5-in. discharge and one a 10-in. suction and 8-in. discharge.

## Automatic Water Purifying System

The purification of water for boiler feed and other industrial purposes is quite essential in many plants. Numerous machines and devices for this purpose are on the market and the selection of one for any particular case depends largely on the cost of installing and operating the same.

An apparatus for water purifying, which is entirely automatic in its operation and one which may be installed for a comparatively moderate price has recently been put on the market by the Geo. W. Lord Co., of Philadelphia, Penn. The apparatus consists principally of one large settling and filtering tank, two mixing tanks, one chemical storage tank, and two measuring chambers.

The incoming water first passes over a waterwheel which furnishes the power to operate paddles in the mixing tanks and chemical storage tank. From the wheel, the water flows to either one or the other of the two mixing tanks directly below, where it comes in contact with the chemicals flowing in by gravity from the chemical storage tank. The solution of chemicals is measured out by an automatic measuring valve, and the speed of operation of this valve varies with the flow of the water. Hence, the correct amount of chemicals is mixed with the water, no matter what the rate of flow may be.

From the mixing tanks, the water flows through a large cylindrical tube, to the bottom of the settling and filter tank where it drops the bulk of the precipitates which are formed, into the cone-shaped hopper bottom of the tank, whence they are removed through a sludge valve designed for this purpose. The water then rises, and after passing through an excelsior filter flows off through the outlet pipe at the top of the tank.

The inlet and outlet pipes of the two mixing tanks are controlled by lever valves, which are automatically operated so as to cause the water to flow first into one and then into the other of the tanks. These valves, as well as the chemical measuring valve, are operated by sets of levers which are shifted by a dumping bucket, the latter being actuated by the weight of water run in from overflow pipes.

A valve in the inlet pipe, which is governed by a float in the filtering tank, controls the entire operation of the apparatus.

## Rules for Firing Shots

The following drilling and shot-firing regulations make for efficiency and safety as well as economy of time, labor and powder:

(1) Holes drilled in solid faces should be 6 ft. apart horizontally.

(2) Extract all coal dust from the drill holes before charging.

(3) Undercutting should extend at least 6 in. beyond the drill hole.

(4) Drill holes should be at the least 2 ft. 6 in. deep.

(5) The bottom of holes drilled in a solid corner should come within 1 ft. of the rib line.

(6) Giant powder should never be issued to miners while it is frozen, and should always be carried in canvas bags.

Boyles law states that, "the volume of a gas is inversely proportional to the pressure upon it, providing the temperature remains the same," hence variations in atmospheric pressure have a marked effect upon the quantity of gas given off by a coal seam. When a reduction in pressure takes place the amount of gas given off increases and gob gas overflows.

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*This journal has a direct aim—a single purpose—which is to help advance the coal-mining industry. Its creed embodies the dissemination of knowledge and the free interchange of ideas among its readers, all of whom are invited to become regular contributors.*

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# COAL AGE

## Investigation of Explosives

Recent discussions by English engineers show that there is the same diversity of opinion on coal-mining problems in Europe as exists in America.

At a December meeting of British mining men, J. J. Prest in speaking of methods for laying coal dust said: "The one fact that stands out to my mind in all these experiments, is that a sufficiently large sum of money has not been placed at the disposal of the experimental committee of the government, to ascertain whether it is not possible to obtain an explosive that will not ignite coal dust.

"We seem to have gone on the other tack of spending thousands of dollars in demonstrating the inflammability and danger of coal dust. Experiments have been repeated, *ad nauseum*, to demonstrate only that coal dust is dangerous, whereas, if a tithe of the money had been spent in the direction of endeavoring to produce an explosive that will not inflame, or cause an explosion where coal dust is present in large quantities, then some of the money would have been usefully spent. I do not think it humanly possible to remove coal dust from the workings of a mine, and all the experiments and suggestions which have been made are simply playing with the subject."

While we do not agree entirely with the views of Mr. Prest, because the money recently expended in this country by the Bureau of Mines on investigations of explosives, has resulted in much good; it is a fact that the greatest basic danger to coal mines would be remedied if explosives could be made absolutely safe.

There has been a considerable advance in the manufacture of mine explosives during the past two years, but the best powders we have today still flame, and when conditions are right, an ignition of gas or dust is liable to occur.

We believe with Mr. Prest that a greater proportion of the money now being spent on investigations leading to safety in coal mining, should be diverted to a serious solution of the explosives problem. The present terms, "permitted," "safety," "flameless," etc., only mean that one powder is a little less dangerous than another brand.

## Some More Electrical Don'ts

The following "don'ts" are submitted for addition to the electrical warning list, recently issued by the Bureau of Mines.

(1) Don't permit the use of timber near your underground electrical pumps and other stationary motors. A fire took place, July 17, 1910, at the Devon colliery of the Alloa Coal Company, Clackmannan, Scotland, in a pump room containing a 70-hp. motor driving a triplex pump. This fire could not have been started by lamps for none were present. It evidently originated at the motor controller because that was the only part seriously burned. The controller was filled with oil which is believed to have ignited, setting fire to the timber and thus filling the mine with a dense cloud of smoke.

How this fire occurred is open to doubt. Either a fuse, in blowing out, ignited the fumes from the 10 or 12 gal. of oil which the resistance and switch-box contained, or else the oil was ignited by a short circuit between the terminals just inside the box. Two men were killed by passing through the smoke. Two other fires occurred: one on Aug. 17, 1910, at Pleasley colliery, Derbyshire, and the other on Oct. 1 at the Manvers Main colliery, Yorkshire. Both these fires were caused by the fusing of a cable at or near the entrance of a pump room, the resulting arc setting fire to the adjacent timber. In 1909 at the Blaenant colliery in South Wales a similar accident occurred with fatal results, and a number of fires have been caused by the same agency.

(2) Don't put a trolley wire or other bare conductor where it may, on falling, cross another bare wire which is not usually charged or is generally charged at a lower potential.

An insulator on an overhead electric line broke and permitted the wire to come in contact with a steel stay. Some cars left the track and made a contact with the

latter. A yard foreman who assisted the driver of the trip received a fatal shock. It is needless to point out how essential it is to protect electric wires from non-electric or from other electric wires of a different potential. Signal wires and shot-firing wires should be kept away from trolley wires.

(3) Don't put a bare wire such as a stack or other stay wire, where on falling it will cross-circuit a trolley wire or bare conductor. This is dangerous because, if the wire breaks as it probably will, between the ground and the trolley wire, there will be no direct grounding, and the return may cause a fire, and electrify a conducting body which normally is harmless.

(4) Don't leave unsafe trees near trolley lines. A motorman in the southern part of West Virginia received a severe shock from a fallen trolley line, the line being brought down by the fall of a rotten tree in a heavy gale.

(5) Don't install your fuses near an oil controller box, for if a fuse burns out ignition of the fumes from the oil may result.

(6) Don't install oil controller boxes when using a low-potential current in mines where naked lights are permitted. In such a case they are a menace without compensating advantages.

(7) Don't hang wires insulated or uninsulated on weak roof unless the roof is protected by adequate timbers.

(8) Don't hang wires, if it can be avoided, on collars supported by posts which are not set back in the rib. This applies especially to curves, where derailments are more frequent than elsewhere. Crossbars set in the coal are to be preferred. If this arrangement is not practicable, put heavy 3-in. plank at the level where the frames of the motor or the flaring of the cars would be likely to strike the timbers on derailment. Then block the timbers securely in place. The electrician would do well to note the condition of the track and timbers in such places.

On May 12, 1910, at the Blantyre Ferme colliery, belonging to Messrs. A. & G. Moore & Co., Scotland, a runaway car displaced some props, which brought down a girder. This cut a cable carrying a three-phase current of 400 volts, but as the neutral point of the system was connected to earth, the displaced girder was charged with only 230 volts. As the girder fell one end was caught on the cable; the other fell on a tie without making a sufficient ground. A workman tried to lift the girder and received a fatal shock. One recent explosion in England was alleged to have been the indirect result of the derailment of a motor. The motor tore down some posts and thus ripped down several feet of trolley wire. A dust explosion was said to have resulted.

(9) Don't omit to keep rubber gloves on hand on all motors and at all electrical pumps and substations for use in emergencies. On March 4, 1910, a motorman at Blackrigg No. 3 colliery of the United Collieries, Ltd., Scotland, got off his motor to work on an electric cable. The cable had a defective joint, which, being insulated by waterproof tape only, permitted the motorman to come in contact with the bare cable. A man offered to pull the motorman off, but this he would not permit. He instructed this man to shut off the current. This the latter failed to do, not knowing which switch to operate. Another man got some india rubber gloves and pulled the motorman off the wire. But by the time this was accomplished he was dead.

(10) Don't omit to ground properly all motor and generator bed plates, transformer coverings, mining-machine frames, boxes for inclosed switches and for junctions and such other exposed parts as are suitable for grounding.

On May 12, 1910, at the Auchengleich colliery, of Messrs. James Nimmo & Co., Scotland, a workman placed his hand on a transformer case in a longwall working. He was standing on an iron plate. The transformer took current at 400 volts and transformed it to 100 volts for use in lighting, the higher pressure being used for a conveyor operating along the face. It appeared that the cable had become worn at the brass bushing where it entered the case. The transformer case was thus electrified. The armoring of the cable might have served for grounding purposes, but apparently was so attached that it was not effective. The cable should be arranged so that there may be no stress on it where it enters the bushing or else a lug on the transformer should be connected to the armoring in such manner as not to be subject to any mechanical stress. A separate ground for the transformer would serve the purpose as well as any other method.

(11) Don't fail to ground the armor of your armored cables frequently, about every 300 to 500 feet.

(12) Don't omit to notice the condition of cables where two wires of different potential enter the cable.

(13) Don't omit to examine the openings or bushings of controllers, transformers, and switch boxes to see that the insulation of the entering cable has not been destroyed by rubbing.

(14) See that all switch boxes and all transformer cases completely inclose the conductors and wiring so that no inquisitive person is liable to be injured.

A boy at Bardykes colliery, belonging to the Summerlee Iron Co., Ltd., in Scotland, May 5, 1910, pushed a wire into a switchbox carrying 500-volt, 3-phase current with fatal results.

(15) Don't place naked live wires where, in oiling, the engineer or machine-runner may come in contact with them. The oiler may be able to turn off the current, but he may neglect to do so.

## Employer's Liability Act

After almost a year's consideration, the U. S. Supreme Court, on Jan. 15, sustained the Employer's Liability Act of 1908. This act replaced one which had been declared unconstitutional, because it attempted to protect intrastate as well as interstate labor.

The act, thus sustained, abolishes the common law concept, which held that the employer was not responsible for the injuries inflicted by a coemployee. Interstate employees must now be defended in their work against the acts of their fellow servants.

Another interesting feature of the law is that it frees the employee or his dependents in some cases from facing the defense of "contributory negligence." In other cases it limits the effect of that doctrine.

The old common law regarded a contract of service as an agreement on the part of the employee to shoulder all the risks incident to that service if the dangers were known to him. The Supreme Court sweeps aside that common-law ruling and permits Congress to make laws which remove such consideration in the settlement of liability cases. No recent act is of more importance to the coal industry, than this latest ruling of our Supreme Court.

# Examination Questions

**Selected from State Examinations, or Suggested by Correspondents**

## Questions for Beginners

### Composition and Properties of Black Powder

*Ques.*—(a) What is the composition of black blasting powder? (b) What are the chief properties of this powder?

*Ans.*—(a) The theoretical composition of black powder is potassium nitrate (niter or saltpeter), $KNO_3$, 75%; carbon (charcoal), C, 12½%; sulphur, S, 12½%. Manufacturers, however, vary these proportions slightly and, in many instances, substitute for potassium nitrate the cheaper nitrate of soda ($NaNO_3$). The proportion of the several ingredients varies in different makes of black powder, as follows: Niter, from 74 to 77%; carbon, from 12 to 20%; sulphur, from 10 to 20%.

(b) The specific gravity of black powder varies from 0.89 to 0.94, so that a cu.ft. of the powder would weigh an average of $62.5 \times 0.92 = 57.5$ lb.; and 1 lb. of powder well rammed occupies $\frac{1728}{57.5} = 30$ cu.in. Exposed to dampness the nitrate salt dissolves, and the powder loses much of its strength. The soda powders are more susceptible to dampness than the niter powders. When powder is heated to 212° F. some sulphur is driven off and the powder loses some of its strength. At 668° F. the sulphur is ignited and the powder explodes. A good gunpowder ignited on a sheet of white paper should burn without blackening the paper.

### Composition and Properties of Dynamite

*Ques.*—(a) What is the composition of dynamite? (b) What are the properties of dynamite?

*Ans.*—(a) Dynamite is nitroglycerin absorbed in some inert porous substance such as sawdust, wood pulp, or infusorial earth, which makes it less liable to accidental explosion when being handled. Nitroglycerin is a chemical compound formed by the action of nitric acid on organic matter. Its symbol is $C_3H_5(NO_3)_3$.

(b) Nitroglycerin is readily exploded by percussion or when heated to 250° F. The dynamite is wrapped in tough oiled paper, forming cartridges about 8 in. long and varying from ⅞ to 3 in. in diameter. The weight, in ounces, of an 8-in. dynamite cartridge is practically five times the square of its diameter in inches. Nitroglycerin freezes at —42° F., and when frozen is difficult to explode; exposed to a heat above 100° F., it evaporates freely, and the dynamite thereby loses its strength.

### Tape Fuse in Blasting

*Ques.*—What is tape fuse?

*Ans.*—There are different kinds and grades of tape fuses adapted to the uses for which they are intended. These all consist of a continuous train of finely powdered gunpowder twisted or enfolded in paper, cotton, hemp, gutta-percha, or other similar covering. In coal mining, single- or double-tape fuse is commonly used, the latter being preferred because of its heavier coverings and better protection against injury in handling and tamping.

### Gases Formed by Explosion of Powder

*Ques.*—What gases are formed by the explosion of black powder, and what is their relative volume?

*Ans.*—The principal gases formed are carbon dioxide, carbon monoxide and nitrogen, with varying smaller amounts of hydrogen sulphide, free hydrogen and marsh gas. These gaseous products vary with the conditions under which the powder is exploded.

The volume of the gases formed by the explosion of black blasting powder, measured at atmospheric pressure and a temperature of 32° F., is practically 360 times the volume of the original powder.

### Pressure Due to Explosion of Powder

*Ques.*—What is the pressure that may be expected to be produced by the explosion of black powder in blasting coal? Show briefly how this pressure may be estimated.

*Ans.*—A pound of black blasting powder occupies about 30 cu.in. If this powder could be exploded instantly, in a confined space, the gases of the explosion would fill two-thirds of the space and have an estimated temperature, at the instant of explosion, of 3600° F. (the computed or theoretical temperature is 4400° F.). The remaining one-third of the space occupied by the powder is filled by the solid products remaining after the explosion. But the large grains of blasting powder burn slowly, in comparison; and, as a consequence, partial rupture of the coal occurs and expansion of the gases takes place with a reduction of temperature to about, say 2000° F., instead of 3600° F.

Since the volume of gases (at 32° F. and 14.7 lb. per sq.in. pressure) is 360 times the volume of the powder (30 cu.in.), there would be in this case $360 \times 30 = 10{,}800$ cu.in. of gas compressed into 20 cu.in. of space, which would increase the pressure in the ratio $\frac{10{,}800}{20} = 540$ times. But the pressure is also increased by the rise of temperature in the ratio $\frac{460 + 2000}{460 + 32} = \frac{2460}{492} = 5$ times.

The total increase of pressure therefore may be estimated at $540 \times 5 = 2700$ times the original pressure, which, in this case, is $\frac{14.7 \times 2700}{2000} = 19{,}845$, say 20 tons per sq.in. The actual pressure may be more or less than this, according to conditions, but this may be assumed to represent a fair average, in mining coal.

### Weight of Charge in Blasting

*Ques.*—What weight of black blasting powder should be used in blasting coal?

*Ans.*—The weight of a charge of powder to be used in breaking coal depends on the strength of the powder and the hardness of the coal, the thickness of the seam, character of the coal strata, size and depth of hole and its position in the seam. In general, these data vary so much that no hard and fast rule can be given, but experience alone must determine the weight of charge that will be safe to employ. The grade of powder used should be in accordance with the hardness of the coal. A shot is well placed when the depth of the center of the charge from the free face of the coal is about equal to the thickness of the stratum of coal to be removed by the shot, provided the coal is not undercut. The axis of the hole should always be inclined to the face of the coal, unless the coal is mined or sheared (sidecut); but always a line drawn from the center of the charge perpendicular to the axis of the hole should strike a face of coal in a distance less than the height of the coal.

If these rules are followed the weight of charge required will never exceed two pounds of black powder, or less, when one of the so called permissible powders is employed that is specially adapted to the coal in question. Approximately, 4 in. of a 3-in. hole, 6 in. of a 2½-in. hole, or 9 in. of a 2-in. hole will contain 1 lb. of powder well rammed.

# Discussion by Readers

**Comment, Criticism and Debate upon Previous Articles, and Letters from Practical Men**

## American vs. English Mine Fatalities

I want to say that I appreciate the article by James T. Beard on the death rate in the mines of the United States, per thousand men employed, in comparison with the same statistics in Great Britain. He states that the comparison should be on the basis of tonnage rather than on the basis of the number of men employed; and, using the figures in his table, I find for the same three years, 1908-1910, inclusive, the average tons mined per life lost in the anthracite district of the state of Pennsylvania was 134,047 tons, while in the bituminous district 247,318 tons were produced for every life lost. In Great Britain for the same period, I find the number of tons mined per life lost was 174,373 tons.

In comparing the production of coal in Pennsylvania with that in Great Britain, it would be manifestly unfair to consider the production in the anthracite field and attempt to compare this with the production for the same period of time in the bituminous mines of England, any more than we would attempt to draw a comparison between the anthracite and bituminous mines of Pennsylvania or any other state.

For example, the production of coal per life lost, 1908-1910, in the anthracite mines of Pennsylvania, is, as I have just stated, only 134,047 tons, as compared with 247,318 tons, during the same time in the bituminous mines of the state. The reason for this increased death rate in the mining of anthracite coal is to be found in the fact that every pound of anthracite coal must be mined by the force of powder. In Great Britain and in the bituminous mines of this country it is quite different, as the coal is undercut and less powder is required or used.

I have worked in the mines of Great Britain for twenty years and know what I am talking about in this regard. While there is considerable powder used in mining coal in Great Britain the amount per ton of coal mined is as nothing compared with the item in the anthracite district of Pennsylvania. The strength of these statistics is easily proved by comparing the tons of coal mined per life lost, in the anthracite district of Pennsylvania, with the same data in the bituminous district of the State, as I have shown above.

In the bituminous district of Pennsylvania 50 per cent. of the coal is mined with pick, while in the anthracite district every pound of coal mined is blasted with powder. Taking the average of the bituminous and anthracite mines, as Prof. Beard's figures clearly show, we have in the state of Pennsylvania 186,937 tons mined, for every life lost; while in Great Britain there were but 174,373 tons mined per life lost or, in other words, the production, including both anthracite and bituminous coal, in the state of Pennsylvania, per life lost, is still higher than the bituminous production alone, in the British Isles.

Pittston, Penn. W. D. OWENS.

## Timber Framing for Side Pressures

In reply to "Timber Foreman," in COAL AGE No. 6, p. 188, I have found in framing for side pressures, that the ordinary notch invariably splits the cap, as shown in Fig. 1. This often happens before the post has taken the full weight of the side pressure.

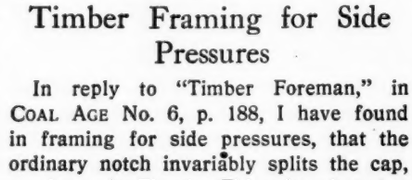


Fig. 1 Fig. 2

METHOD OF FRAMING

To avoid this, I have added 2 in. to the thickness of the leg and cut my cap at 45 deg. and the leg the same plus the batter. Then by nailing the piece cut from the leg in the corner, and driving two small track spikes in the cap and two in the leg, as shown at *N N*, Fig. 2, a strong durable joint is obtained.

This is a quick and simple way, and I have never known it to fail.

JOSEPH VIRGIN.

Plymouth, W. Va.

## Textbooks at Examinations

In your issue of December 23 you advocate that aspirants be granted the privilege of using their textbooks at fireboss' and mine foreman's examinations. I cannot grasp your argument. Do you think that failure to pass is merely a sign of weakness of memory? To my mind, the defect is rather that the applicants for certificates don't try to memorize the rules, and they don't study enough to know the whys, the whens and the wheres from which those rules originate. I am of the opinion that the examinations should become more technical, so that those who desire to pass will read and study more. I think also, that a person seeking a certificate as fireboss should have at least ten years' practical experience in coal mines and he should serve two years as fireboss before being granted the further distinction of mine foremanship.

We are becoming more enlightened and progressive year by year. Yet we believe that a man can get a sufficient experience in a few years. We used to go to work with our fathers and learn by long experience what were the difficulties to be met with in mining and we would profit by what we were told. But now so short a period of time is spent in learning the problems at the face that there are many who are seeking certificates who have not materially benefited by others' experience or theories.

Moreover, even if the examinations are too trying mathematically for the practical man it must be admitted that all the examining boards deal leniently with him, believing that figures are less important than the facts of actual practice. They don't expect him, or themselves, to know all the latest developments of science or its more profound depths.

I should like to hear someone else express his opinions, someone who has worked such long shifts in the mines that his dinner bucket dragged the ground as he struck the trail for home after working for 10 or 12 hours, and who has nevertheless memorized the rules and formulas and needs no book in hand to solve the problems presented.

IAGO.

Marion, Ill.

## An Efficient Arrangement

In one of our gaseous mines where all hauling on the intake entries is done in the day time, we have found that a combination of steam jets and water sprays is the best method of laying the dust. When hauling is being done the water sprays are used. During the night, when haulage has ceased, the steam spray is turned on and the main entries and intake are thoroughly moistened.

Birmingham, Ala. FOREMAN.

# Inquiries of General Interest

**All Questions Must be Accompanied by Name and Address—Not for Publication**

## Size of Rope, Deep Shafts

Please give me a formula for calculating the size of a wire rope that will be capable of hoisting a given load, say 5½ tons, including the weight of the cage, car and coal, making due allowance for the weight of the rope and friction, assuming a certain depth of shaft, say 150 yards. What is meant by factor of safety?

MINE FOREMAN.

Dunfermline, Ill.

Add one-tenth of the load to be hoisted, to allow for the friction of the hoist, which makes the total load at the end of the rope, in this case, $5.5 \times 1.1 = 6.05$ tons. The load on the rope at top of shaft is greater than this by the weight of the rope, which depends on its diameter ($d$), in inches, and the depth of the shaft ($D$), in feet.

Since the weight of a 1-in. wire rope is 1.58 lb. per foot, and the weight varies with the square of the diameter of the rope, the weight of any wire rope whose diameter is $d$ is $1.58\,d^2$ lb. per lineal foot. The weight of the rope hanging in the shaft is then $(1.58\,d^2)D$ lb.; or for a shaft 150 yd. (450 ft.) deep the weight of rope is $1.58 \times 450 \times d^2 = 711\,d^2$ lb.; or dividing by 2000 to reduce to tons, $\frac{711}{2000}\,d^2 = 0.3555\,d^2$ tons. The total load on rope, including its own weight and the friction of the hoist, is then,

$$(6.05 + 0.3555\,d^2) \text{ tons.}$$

The breaking load of wire ropes depends, of course, on the material, as being iron, crucible or cast steel, extra-strong crucible steel, or plow steel. The strength of ropes, like their weight, varies with the square of the diameter. Here also, the strength must be calculated from the strength of the 1-in. rope, which is given below for different kinds of haulage and hoisting ropes.

BREAKING STRAINS OF DIFFERENT WIRE ROPES, 1 INCH IN DIAMETER

| Kind of Wire | Breaking Strain, In Tons | |
|---|---|---|
| | Haulage Ropes, 6-strand, 7-wire | Hoisting Ropes, 6-strand, 19-wire |
| Iron | 16 | 17 |
| Cast-steel | 32 | 34 |
| Extra-strong cast-steel | 37 | 39 |
| Plow-steel | 42 | 44 |

Since the breaking strain of a 1-in. extra-strong, cast-steel hoisting rope, in the table, is 39 tons, the breaking strength of the same kind of rope whose diameter is $d$ is $39\,d^2$.

The given working load, in this case, is $(6.05 + 0.3555\,d^2)$ tons. If we allow here a factor of safety of, say 6, which means the allowable working load is only one-sixth of the breaking strength of the rope, the breaking load would be $6(6.05 + 0.3555\,d^2)$ tons.

Then equating the breaking strength of the rope ($39\,d^2$ tons) with this breaking load and finding the value of $d$, we have for the required diameter of the rope

$$39\,d^2 = 6(6.05 + 0.3555\,d^2)$$
$$d^2(39 - 2.133) = 36.3$$
$$d = \sqrt{\frac{36.3}{36.867}} = \sqrt{0.9846} = 0.99, \text{ say } 1''$$

A 1-in., 6-strand, 19-wire, extra-strong, cast-steel rope will, therefore, be capable of hoisting a gross load of 5½ tons in a shaft 450 ft. deep, making due allowance for the weight of the rope and friction.

## Mine Timber for Airways and Rooms

In our coal tract there is a considerable acreage of good oak timber, with a large proportion of hickory. We are anxious to use this timber to the best advantage in the mine. Will you kindly give us a little advice in regard to the cutting, storing and use of this timber in the mine?

MINE OPERATOR.

Oskaloosa, Iowa.

Mine timber should be cut in the winter months, from, say December to February, inclusive. The reason for this is that during this period of practically three months, growing timber contains less sap than at any other time of the year. Commonly, the sap ceases to run late in November and does not start again till late in February or early in March, depending upon location, exposure and progress of seasons. Timber cut during the period named is more readily seasoned and endures longer in the mine than timber cut while sap is running.

The cut timber is sawed or cut into lengths suited to the requirements of the mine, either at the time or shortly after cutting. Prop timber is best stored in a dry yard or shed, standing the posts on end, which allows better drainage and more complete seasoning than when piled in horizontal layers.

In cutting, as far as practicable, the large logs should be reserved for timbering shaft or slope bottoms, or landings and partings. The 6- and 8-in. timber make the most serviceable posts; the 4- and 5-in. sticks make good ties and the lighter 3-in. stuff can be used for lagging. Cap pieces should be 16 or 18 in. long, about 8 or 10 in. wide and 1½ or 2 in. thick. These should be cut from the waste ends of the large logs. All posts should be properly squared on each end.

The hickory timber should be used, as far as practicable, in rooms and other places, on cross-entries and temporary roads where the long life of the timber is not as necessary as on the main airways and haulage roads. A hickory stick makes a good room post. The oak timber should be reserved for all main roads and air-courses. Cap pieces should generally be made of the softer wood, and wedges of oak.

Mine rails for use in rooms must be sawed from large oak logs, selected carefully for their straight grain and freedom from knots. The size in common use is 2x4 in., in 12 and 16-ft. lengths.

## Hospitals at Anthracite Mines

Will you kindly tell me if the Pennsylvania laws, with reference to hospitals, are observed in letter by the anthracite coal companies.

Philadelphia, Penn. W. R. C.

The hospitals of the anthracite mines of Pennsylvania fulfill not only the letter of the law, which compelled their establishment, but its spirit as well. The maintenance of good hospitals has become a matter of pride with the anthracite companies. The equipment is simple and easily kept clean. It usually consists of one or two tables, a reclining Morris chair, stretchers and a box of supplies, which is usually very much more complete than is required by the law. Wherever possible the underground hospitals are steam-heated, lighted by electricity, and provided with hot and cold water. The floors are cement and the walls whitewashed. In order that the injured may be carried to the hospital or to the surface with the minimum of discomfort, the Lehigh Valley Coal Company uses an ambulance car. The frame is similar to that of an ordinary mine car but the car body is supported by springs to reduce the jar of movement. Each car has two stretchers attached, also a seat at each end of the car for attendants.

# Coal and Coke News

**From Our Own Representatives in Various Important Mining Centers**

## Washington, D. C.

Opinions have already been expressed here rather freely in criticism of the plan announced by the Lehigh Valley R.R. Co. for dealing with the stock of the Lehigh Valley Coal Co. in order to bring the present organization into conformity with the commodities clause of the interstate commerce law. A study of the details of the plan as announced in New York has led government officials to the view that whether the plan is legal or not, it will require a somewhat lengthy litigation to demonstrate its legality or the reverse.

In fact, there are a good many persons here who believe that it would be advisable for Congress to undertake further legislation on the commodities clause in order to make the meaning plainer and to give effect to the intent of those who originally framed the proposition. Such action has been suggested for some time past and in this connection it has been urged that the Department of Justice should draw up a provision embodying the commodities clause in a revised form and intended to cover the whole requirements of the situation as understood by the government today. It is decidedly doubtful, however, whether anything could be done on the subject at this session of Congress, and meanwhile attention will be given by the law officers of the government to the Lehigh plan as now stated, in order to determine whether or not it is incumbent upon them to seek a further test in the courts.

### Scheme of Organization

There is a decided opinion among these officials that although the scheme is undoubtedly ingenious, it is, nevertheless, obviously a method of evading the plain intent of the law as understood here. The understanding of the scheme among those who have been devoting their attention to it is that under the new plan the coal company continues to hold and operate the coal mines as a corporation of the State of Pennsylvania and a new concern called the "Lehigh Valley Coal Sales Co." is organized. This coal sales company has no organic connection with the Lehigh Valley Coal Co., but is to make a contract with the latter, and by the terms of this contract, the sales company will purchase and sell such coal as may be owned or acquired by the coal company, whether already on hand, purchased or mined.

Meanwhile a dividend has been declared which is sufficient in amount to pay for the stock that the coal sales company will issue, and this stock will be apportioned among the railroad's stockholders. While, of course, the railroad stockholders will not be obliged to purchase the stock of the coal sales company, and provision will be made for issuing these shares through the intermediation of an underwriting syndicate, there will, nevertheless, thus be established a mining company with shares that are the direct property of the railroad, and this mining company will contract to sell its coal to a sales company whose stockholders, probably, will be almost identical with those of the railroad company.

### A Parallel Case

An analogy has been drawn between this scheme and the situation created by the connection between the National City Bank and the National City Co. which was last summer held to be illegal by Attorney General Wickersham. This illegality was not charged on the ground of any direct prohibition contained in the national-bank act, but was based on the fact that the plain intent of the bank act was being defeated by means of the plan in question. It is alleged that the same objection would hold good in regard to this scheme in connection with the mining and selling of coal, it being said to be in direct contravention of the obvious intent of the commodities clause, whether or not against the letter of the law.

### Oklahoma Coal Leases

Mr. Carter has offered a bill (H. R. 17,479) that grants to the coal-mining companies of the State of Oklahoma the right to acquire additional acreage adjoining their mine bases. The bill in part provides:

"That the Secretary of the Interior, under rules and regulations to be prescribed by him, may grant to any coal-mining corporation, individual, or individuals, operating a coal mine or mines in the State of Oklahoma, the right to acquire additional acreage from the unleased segregated coal land of the Choctaw and Chickasaw Nations, in the State of Oklahoma: *Provided*, That the land sought to be acquired adjoins and is contiguous to the coal-mining property in operation:

*"Provided further*, That the right to acquire such additional lands shall extend only to coal-mining corporations, individual, or individuals, actually operating coal mines in said state in good faith: *And provided further*, That the lease or leases on such additional coal lands shall not be made for a longer period of time than existing leases, and shall not be made at a less rate of royalty than the rate of royalty paid on existing leases now in operation in said State of Oklahoma."

## Alabama

*Birmingham* — Consolidation of the Woodward Iron Co. and the Birmingham Coal & Iron Co. will not become effective until Feb. 1. The assumption of control by the Woodward company of the recently acquired properties of the Birmingham company is delayed to complete inventories and arrange a number of minor details.

Three hundred and fifty state convicts were removed, Jan. 1, from the Pratt mines of the Tennessee Coal, Iron & R.R. Co. to the Banner mines of the Pratt Consolidated Coal Co., and 250 county convicts were at the same time transferred by the latter company from Banner to Flat Creek mines.

The Sayreton mine of the Republic Iron & Steel Co. holds the state record for the largest production of coal in 1911. The record for output was previously held by the Flat Top mine of the Sloss-Sheffield company, which now ranks second.

## Arkansas

*Fort Smith*—A statute making coal and railroad companies responsible for damages to employees from personal injuries due to the negligence of fellow servants has been upheld as constitutional by the Supreme Court of Arkansas.

## Colorado

*Cañon City*—One hundred miners went on strike, Jan. 4, at the Ocean Wave mine of the Rocky Mountain Fuel Co., at Williamsburg, over differences arising in regard to the rate for removing "brushings." It is said the men have recently become organized by representatives of the union. After a general conference on Jan. 8, all but 40 of the strikers returned to work.

*Denver*—The state land board has granted a lease of coal lands to R. W. Dymond, of Denver, reserving to the state the right to dictate the price at which coal shall be sold from the land. This is

the first time in the history of Colorado that the state has undertaken thus to fix prices. Dymond will be permitted to sell the coal at 50c. profit per ton. The board will fix the absolute price after finding out how much it costs to mine the coal. The lease applies to 640 acres of coal land near Como.

*Erie*—So far as can be learned there is no change in strike conditions here, but it is said there is evidence that matters are shaping themselves for a big strike in the southern part of the state. If this is so, there will be no settlement of the Erie strike, and the mine owners are working on this theory.

## Illinois

*Bloomington*—A serious coal famine exists in most of the smaller towns of central Illinois and mines here are besieged with orders.

*Staunton*—One man was killed instantly, another injured and a half-dozen others, all miners, had a narrow escape in a cave-in, Jan. 6, at the De Camp mine, near here.

*Du Quoin*—Six prospect holes have been drilled on a 17,000-acre tract of coal land near Waltonville, about 15 miles east of Sunfield and north of Christopher. These show a seam of coal ranging from 6 ft. to 7 ft. 6 in. in thickness, and the property owners have appointed a committee to arrange for the sale of the land.

*Carlyle*—Tests for oil have revealed the existence of large beds of coal to the west and north of here. The coal has been found at depths ranging from 400 to 425 ft. The veins range from 5 to 12 ft. thick, and in some places two seams 6 ft. thick have been found. The tests indicate that the townships of Carlyle, Santa Fe, Wade, Wheatfield and Irishtown are underlaid by unusually large deposits.

*Chicago*—It is understood that the Illinois coal operators have joined the American Mining Congress in a body. This means the addition of about 100 members and involves an educational fund of $2000.

## Indiana

*Indianapolis*—The official call for a joint wage conference of coal miners and operators from throughout the coal-producing regions of the United States was issued here, Jan. 11. The conference will convene here on Jan. 25. Miners and operators from Indiana, Illinois, Ohio, Pennsylvania and West Virginia will be represented. Wage contracts in practically all bituminous and anthracite regions expire on Apr. 1. More than 400,000 miners, a large number of whom are members of the United Mine Workers, will be affected. The wage conference will be held in connection with the annual convention of the United Mine Workers.

*Brazil*—Brazil coal operators are receiving appeals for coal from many cities that are experiencing famines. Rushville and several cities in eastern Indiana that have been depending on natural gas are out of coal. All the mines of this section, which have been running but half time all winter, are now working full time and giving employment to every miner who can be engaged. Much trouble is being experienced by the coal companies in moving the coal on account of the snow and the intense cold.

## Iowa

*Chariton*—J. F. Spiker is negotiating with the Albia Coal Co., of Albia and Oskaloosa, in regard to leasing about 3000 acres of coal land in Lucas County to that company. It is reported that development in this region may be expected in advance of the completion of the new line of the Rock Island R.R.

## Kentucky

*Henderson*—The property of the Southern Coal & Transportation Co., consisting of about 8000 acres of coal rights, together with developments and equipment, was bought by M. V. Denton at a public sale at Robards, Jan. 1, for $93,335, the appraised value being $140,000. It is reported that the Panama Coal Co., composed of M. V. Denton, O. W. Rash and others, will operate the mines.

*Madisonville*—The Reinecke Coal Mining Co. has sold its coal mine and property near Madisonville to the Clear Creek Coal Co. The property transferred is one of the largest producing coal mines in the state. It employs about 200 men and has an admirable uptodate equipment. The grantee is a corporation recently organized by Eastern capitalists to take over this and other properties in western Kentucky. There will be no change in the management or operation of the Reinecke mine for the present.

## Minnesota

*Wells*—While digging a trench on the farm of Henry Menerich, of Mansfield township, workmen found a vein of lignite coal of excellent quality. The depth at which the coal was found was about 12 ft., and investigations will be made to ascertain if there is coal in sufficient quantities to warrant mining for commercial purposes.

## Missouri

*St. Louis.*—Contemplating an extension of the Southern Traction Co. being constructed from St. Louis to Belleville, from the latter city to the rich coal fields of southern Illinois, and the completion of the St. Louis and St. Libory road through the southern portion of St. Clair County, the Donk Brothers Coal & Coke Co. of St. Louis, is buying up extensive coal rights in St. Clair, Randolph and Washington Counties, principally north of the Illinois Central Railroad. The company is said to have made exhaustive borings in southern Illinois, where it is operating, and, while the officers have made no statement as to how they expect to reach the St. Louis markets, it is said they are depending on the extension of the Southern Traction Co. lines, which will probably interlace the rich mining and farming lands near Marissa, Tilden and other St. Clair, Randolph and Washington County towns. There is also a report that the Mobile and Ohio Railway is considering the construction of a branch line from Sparta to Marissa.

## Montana

*Three Forks*—That coal in large quantities may underlie the Gallatin valley is indicated by the discovery here of a 7-ft. vein of what appears to be an excellent grade of coal. The discovery was made recently by well diggers on the property of the Milwaukee & St. Paul R.R.

*Helena*—Argument was concluded Jan. 6 in the case of the Montana, Wyoming & Southern Ry. Co. against the Montana Railroad Commission. The railroad seeks to restrain the commission from reducing the rate on coal between Bear Creek and Bridger from 45c. a ton to 35c., on the ground that the lower rate is confiscatory. The Bear Creek operators contend that they cannot compete with operators of other districts if the higher rate remains in effect.

## Ohio

*Wellston*—Foreign capital, interested by B. F. Howland and C. F. Butterfield, of New York, and E. B. Bingham, of Toledo, will subscribe to most of the stock of a company to be organized at Wellston, for the purpose of developing southern Ohio timber and coal lands and completing a railroad to Lake Erie. For a number of years the men behind the deal have held options on coal and timber lands in Jackson and Scioto Counties. They report having raised $8,000,000 for a railroad from Portsmouth through Wellston to Lake Erie at a point near Sandusky.

*Bridgeport*—It is understood here that the proposed $25,000,000 merger of eastern Ohio coal properties will be consummated in February, although it is claimed that the merger has been deferred until a decision is reached in the case of the Pittsburg vein coal operators of district No. 8 against the Pennsylvania and Wheeling & Lake Erie railroads. It is said that in the event of a decision unfavorable to the operators, the merger will fall through.

The Lorain Coal & Dock Co. plans to make extensive improvements to its mines

at Crescent, including the erection of a large steel tipple. The work will be started in the early spring.

*Columbus*—The legal battle of the State of Ohio for exclusive power over freight and passenger rates within its borders opened at Washington, D. C., Jan. 10, when Attorney General Hogan, of Ohio, filed a brief in the U. S. Supreme Court supporting the right of the state to fix rates on coal from certain mines in Ohio to Lake Erie ports within the state. The railroads contend that the coal is not destined for lake ports, but is a part of interstate shipments. The case is set for oral argument on Feb. 19.

The Capitania Development Co., of Toledo, has been organized with a capital stock of $10,000, which, however, is to be largely increased in the near future. The officers of the company are Thomas H. Tracy, of Toledo, president; George M. Jones, of Toledo, vice-president and treasurer; J. J. Robinson, of Toledo, secretary. The men interested in the new company have purchased 21,500 acres of undeveloped coal lands in Belmont County and also the Ohio River & Western R.R. Co., operating a steam line of 112 miles from Zanesville to Bellaire. The purchase price is said to have been $3,000,000. The railroad, now a narrow gage, is to be made standard gage at once and two mines will be opened this spring. The plans of the company contemplate the opening of two new mines each year for some time.

## Pennsylvania

BITUMINOUS

*New Castle*—Two men were entombed and probably killed, Jan. 9, in the cave-in of a small mine, eight miles west of here.

*Monongahela*—The mines at Van Voorhis, Acme, Ellsworth and Cokeburg are in operation, and are making fairly good time. At Marianna the mines average about three days a week. Hazel Kirk No. 1 and Dunkirk are idle for the present.

*DuBois*—The new Chickasaw mines of the Shawmut Mining Co., among the largest and most complete in this section of the country, have been organized by the United Mine Workers and will work under their agreement. It is said that the capacity of these mines will be about 2500 tons daily.

*Portage*—The Puritan mine, now owned by the Martin Coal Co., resumed operations, Jan. 15, on an extensive scale. The company was recently awarded $74,323 in a suit against the Pennsylvania R.R. Co. for alleged discrimination in the distribution of coal cars.

*Tyrone*—The U. S. Circuit Court of Appeals has refused to set aside the judgment of the Circuit Court awarding $62,658 damages to seven coal companies operating in the Clearfield district in their suit against the Pennsylvania R.R. Co. for rebates and concessions granted competitive companies.

*Connellsville* — The Thompson - Connellsville Coke Co. has closed a contract with the Inland Steel Co. for 15,000 tons of coke per month. This contract, together with that of the Connellsville company with Jones & Laughlin and others, will take the entire output of the plant and its 800 ovens will be kept in full blast to supply the demand.

*Uniontown*—The hearing of the case of the Independent Coke Producers' Association of Uniontown against the Baltimore & Ohio and other railroads before the Interstate Commerce Commission, which was scheduled to be called on Jan. 15, at Washington, D. C., has been indefinitely postponed.

ANTHRACITE

*Scranton*—President Truesdale, of the Lackawanna R.R., admitted, Jan. 10, that the demands of the coal miners, who are threatening a strike, have been received by the operators. He announced that the request of the miners for a conference on the wage scale would be granted and that the meeting would probably be held some time in February.

*Wilkes-Barre*—The Conyngham colliery of the Delaware & Hudson Coal Co., at North Wilkes-Barre, has resumed operation after being idle for nearly three years following the abandonment of the old breaker. Coal is now carried underground by electric haulage to the company's No. 5 breaker.

While engaged in timbering in the No. 9 slope of the Parrish colliery, of the Parrish Coal Co., Plymouth, in the afternoon of Jan. 9, six men were instantly killed and two severely injured by an explosion. Colliery officials say that the explosion was one of dynamite, but are at a loss to explain how dynamite came to be stored in the slope.

*Pottsville*—Preparations are now under way to tap a vast underground body of water that is backed up in the old abandoned workings of the Maryd colliery, in the Schuylkill valley, near Tuscarora. A large area of virgin coal will then be mined.

It is reported that the Philadelphia & Reading Coal & Iron Co., aroused by recent fires, has started to equip all its mines and collieries with telephone service.

## Washington

*Centralia*—A 12-ft. vein of coal has been discovered underlying the 40-acre farm of D. W. Leonard, just east of Centralia. The coal appears to be of a superior quality to any yet discovered in this vicinity, and Mr. Leonard is casting about for means to start mining operations and place the coal on the market. The property is only a few hundred feet from the Centralia & Eastern R.R., and near the mines of the Mendota Coal Co., thus making the situation particularly advantageous for mining and marketing the fuel.

## West Virginia

*Fairmont*—Heroic work by miners recently prevented a large loss by fire to Consolidation Coal Co. property, at Montana. Breaking out from an unknown origin the flames destroyed the blacksmith shop at the mines and for an hour threatened the tipple and opening. The tipple was but slightly damaged while the opening was protected. The loss is estimated as being in the neighborhood of $1200. The Montana mine, which is one of the pioneers of the region, has been unfortunate with fires.

*Morgantown*—The Consolidation Coal Co., of Fairmont, recently made the location for a shaft on the O. J. Eddy farm, about six miles up Indian Creek. This is a part of the Millholland tract of coal land, aggregating something like 12,000 acres, taken over by the Consolidation Co. several years ago. Prospects are good for the development of these valuable coal lands immediately upon the completion of the Buckhannon & Northern and the extension of the Monongahela R.R. to the state line.

## Wyoming

The United States Circuit Court of Appeals, Jan. 13, condemned the practice of using dummy entrymen to obtain for a corporation more than its proper share of public lands. In the case of the Owl Creek Coal Co., it was alleged that 14 individuals had filed entries on 1760 acres of government coal land for the purpose of turning the property over to the corporation. The lower court had released the defendants, but the court of appeals reversed this decision on the ground that it would invalidate the whole act prohibiting such practice.

## Canada

*British Columbia*—Officials of the United Mine Workers of America are at Vancouver Island, organizing a new district of mine workers.

*New Brunswick*—On Jan. 11, Sir Thomas Tait took over control of the Frederick & Grand Lake Coal & Ry. Co. Extensive plans will be carried out for the development of the Grand Lake coal areas, including the building of a railway for 30 miles from Gibson to Unito for supplying the Canadian Pacific Ry. with 10,000 tons of coal annually. Construction work on the railroad will be started early in the spring.

## Personals

E. L. Booth has been elected president of the Empire Coal Co., of Montreal, Canada. Mr. Booth was formerly second vice-president in charge of the Chicago offices.

Edward M. Mancourt, formerly manager for the Consolidation Coal Co., in Detroit, has been appointed general western manager for the company, with offices in Chicago.

O. H. Reinholt severed his connection with the U. S. Bureau of Mines, Jan. 14, at the expiration of leave of absence, and will resume private practice as a mining engineer with headquarters at San Diego, Calif. .

Charles C. Renshaw, for a number of years manager of the Altoona Coal & Coke Co., has become identified with the firm of Tatnal, Lee & Co., Philadelphia, Penn., with offices in the Stephen Girard Building.

W. H. Loomis, lately with G. B. Markle & Co., at Jeddo, Penn., has become president and general manager of the Rock Hill Coal & Iron Co., following the separation of this company from the East Broad Top R.R. Co.

J. E. Leonard, of the Chehalis Coal Co. was in Spokane recently and exhibited samples of some exceptionally fine coal, taken from his Coal Creek mine. The coal is as nearly of a true bituminous quality as any yet found in western Washington.

Sam Dixon, president of the New River Coal Co. and of the White Oak Ry. Co., recently appeared before the Interstate Commerce Commission, at Washington, D. C., in connection with a complaint against the Chesapeake & Ohio R.R. in regard to the apportionment of rates.

Dr. M. J. Shields, of the American Red Cross Society, is now introducing first aid on the lines of New York Central, the New York, New Haven & Hartford and the Lackawanna railroads entering New York City. He is accompanied by Dr. Mackey, formerly of Scranton, Penn. On completion of this work, Dr. Shields intends to take his car to Washington, D. C., and will there attend the International Meet of the Red Cross Society.

## Obituary

E. S. McKinley, Jr., general superintendent of the Oak Creek Mine, of the Yampa Valley Coal Co., was killed recently at the mine by falling on the tracks in front of a loaded car and being crushed beneath the wheels; he died while being rushed to Denver on a special train. Mr. McKinley was 28 years of age and a graduate of Cornell University in mechanical engineering. His death is deeply regretted in Denver, where he was widely known and greatly esteemed.

## Construction News

*Bridgeport, Ohio*—The Lorain Coal & Dock Co. plans making extensive improvements at its Crescent mines, including the erection of a new steel tipple. Work will be started early in the spring.

*Pittsburg, Penn.*—The Pittsburg Coal Co. is taking bids for the sinking of two shafts: one, approximately 136 ft. deep, on the Jones Ray farm, and one, approximately 151 ft. deep, at the Yough Slope Mine. Plans and specifications are on file at the office of the chief engineer, Oliver Building, Pittsburg.

Bids are being taken on buildings and equipment for the new plant of the Cross Creek Coal Co., Nurgettstown, Penn., which includes: A new tipple; power house, 50x100; boilers of 1200 hp., coal picker, stokers, electric generators, fan and ventilating plant, pumps, motors; railway and mine trackage and electric mining machinery.

*Fort Collins, Colo.*—The Fort Collins Mining & Coal Co. has increased its capitalization from $50,000 to $150,000 and expects to sink a shaft and install complete mining equipment for operation within the year.

*Castle Rock, Wash.*—H. B. Davies and associates, of Tacoma, have leased the Huntington Coal property, two miles south of here, and will equip it with modern machinery for operation on a large scale.

E. N. Ouimette, of New York City, and associates, are reported to contemplate the erection of a $300,000 briquetting plant near Castle Rock.

*Medford, Ore.*—Pierce, Manley & Wallace, of Seattle, Wash., have purchased the Cascade Mine and will install new machinery.

*Birmingham, Ala.*—It is reported that the Tennessee Coal, Iron & R.R. Co. will build 50 miners' houses at Mine No. 2, near Ensley, and about 200 houses at Mine No. 12.

*Columbus, Ohio*—The Capitania Development Co., of Toledo, has been incorporated with $10,000 capital stock, which will be greatly increased in the near future. Men interested in the new company have bought 21,500 acres of coal land and the Ohio River & Western R.R. Co.'s 112 miles of narrow-gage track from Zanesville to Bellaire. Railroad will be made standard gage at once and two mines opened this spring. Plans contemplate the opening of two mines each year until property is fully developed. Thomas H. Tracy, Toledo, is president.

*Victoria, B. C.*—The Canadian Collieries (Dunsmuir), Ltd., will expend $750,000 during the next year for additions to its plant and machinery and for further development of its coal properties. This will be in addition to contracts which the company has recently awarded in connection with a hydro-electric power plant project.

## Recent Incorporations

*St. Louis, Mo.*—The Sterling Coal & Mining Co.; capital, $60,000. Incorporators: S. A. Meddaugh, H. Brown and A. B. Rushton.

*Toledo, Ohio*—The Capitana Development Co., to own and operate coal mines in various parts of Ohio; capital, $10,000. Incorporators: George M. Jones, James J. Robinson and John Craig.

*Austin, Tex.*—The State Lumber & Coal Co., of Texas City; capital, $15,000. Incorporators: F. J. Marett, J. M. Proctor and J. Stanley Carothers.

*Dover, Del.*—The Clear Creek Coal Co., to operate coal mines in Kentucky and market coal; capital, $100,000.

*Wheeling, W. Va.*—The Spruce Bend Coal Co., of Bend, W. Va., to mine coal and manufacture lumber in Logan County; capital, $200,000, of which $10,000 has been subscribed and $1000 paid. Incorporators: P. M. Sharples, and others of West Chester, Penn.

The Arcadian Coal Co., to mine and develop coal and mineral lands and manufacture lumber in Braxton and Webster Counties, W. Va.; capital, $200,000. Incorporators: Thomas McCabe, Cleveland, Ohio; M. J. Sullivan, Latrobe, Penn., and others.

*Wilmington, Del.*—The Gordon Coal Co.; capital, $1,000,000. Incorporators: M. B. Hughes and J. G. Gray, of Philadelphia, Penn.

*Columbus, Ohio*—The Dean Coal & Coke Co., to mine and sell coal and coke; capital stock, $10,000. Incorporators, S. E. Dean, J. A. Stalter, J. R. Elder and others.

*Montgomery, Ala.*—The Nauvoo Consolidated Coal Co.; capital stock, $12,000. Incorporators, R. S. Shook, A. S. Tubb and E. M. Martin.

## Foreign News

*England*—The final ballots of the English coal miners for or against a national strike, which will affect 900,000 men, were cast Jan. 12. The results will show a vote overwhelmingly in favor of a national stoppage. Reports indicate that fully 80 per cent. of the men have gone on record as favoring a strike. A full month, however, must elapse before the strike can become effective, as the miners are under agreement to give notice before stopping work.

## Miners' Convention

SPECIAL CORRESPONDENCE

Division of opinion as to the policy to be pursued by the bituminous and anthracite coal miners' unions of the country in attempting to enforce a demand for higher wages appeared among the leaders of the United Mine Workers of America when its annual convention opened in Indianapolis, Jan. 16. Some 1300 delegates representing 300,000 miners were present.

The question, which will be brought before the convention, is whether the individual districts of the miners' general union shall sign new wage contracts with mine owners, as they can be negotiated, or whether the miners as a national organization shall refuse to sign any contracts until the operators of all the districts have agreed to the miners' terms.

### PRESIDENT WHITE'S REPORT

President John P. White in his annual report, said that the new wage contracts with the mine owners, to go into effect on Apr. 1, made it necessary for the United Mine Workers to put aside internal dissension and prepare to struggle for advancement.

"So far as I am concerned, and I think I voice the sentiments of the rank and file, it is my opinion that our policy should be such as to leave no doubt in the mind of anyone that there will be no reductions from existing wage contracts, and we should earnestly strive for such advancements as it is within the range of possibilities to secure. While we will never surrender the right to strike, we should not lose sight of the fact that some of the greatest successes our organization has ever achieved lay in the channels of peace."

Of the condition of the union in the anthracite field largely in Pennsylvania, in the present crisis, President White reported: "The problem of organizing the anthracite mine workers and building up a strong organization in that field has been a matter of serious concern to our movement for many years. The small membership reported in the anthracite field indicates that the miners are indifferent to their surroundings."

### INTERSTATE AGREEMENT

The president reported that efforts were under way to bring about a joint conference between miners and operators of the bituminous fields of western Pennsylvania, West Virginia, Ohio, Indiana and Illinois, to discuss the terms of the new wage contract, at the close of the present miners' convention.

While he declined to commit himself in the matter, Vice-President Frank J. Hayes said that opposition to the policy of a national strike will come largely from officials of districts bordering on unorganized coal fields.

"It must be remembered that while the United Mine Workers have a membership of nearly 300,000, there are about 450,000 coal miners that are unorganized," said Mr. Hayes. "The question as to whether we should hold out for a national agreement, though in some districts the operators come to our terms, is a serious one."

## Anthracite Miners and Operators

SPECIAL CORRESPONDENCE

The demands of the anthracite miners, as formulated at the three-district convention in Pottsville last fall, are now in the hands of the operators. The miners' representatives have asked for a conference with representatives of the operators, to be held some time in February, and in all probability such a meeting will take place in New York or Philadelphia at the time indicated.

President William Truesdale, of the Lackawanna Coal Co., was in Scranton recently, and in the course of an interview, said: "I have no objections to meeting representatives of the miners' union," carefully indicating, however, that he spoke only for himself. Nevertheless, it may be accepted as a fact that the operators will offer no objections to negotiating with the men who are union officers, and there will thus be avoided the useless delay and uncertainty which prevailed three years ago, when the operators at first refused to deal with the officials of the miners' union, as representing the body of workmen.

As has been frequently stated, the miners have made a series of demands in which the principal items are as follows: (1) Recognition of the union with the introduction of the "check-off" system; (2) a 20 per cent. increase in wages; (3) a one-year agreement; (4) payment for coal by ton instead of by car, wherever practicable; (5) an eight-hour day. There are also a number of secondary demands, but these will hardly be taken into consideration during the course of negotiations.

It should be stated that the operators have permitted it to become definitely known that the majority of these demands are not likely to become the basis of a new agreement. The "check-off" system is particularly obnoxious to the operators, and it may also be stated that it is not desired by the great majority of anthracite miners.

On the other hand, it is understood that the operators are willing to make some substantial concessions to the miners on the basis of the existing agreement, and in all probability they will have their way in this, as the union is scarcely in a position to inaugurate and sustain a prolonged strike. It has exaggerated its demands, and it may be anticipated that the operators will at first exaggerate their determination to grant no concessions, but unless some unforeseen contingency arises, it now seems probable that a satisfactory compromise will be reached without involving a strike.

## Institute Meetings

The Y. M. C. A. mining institutes of the Pennsylvania anthracite region now have an aggregate membership of over 5000 mining men. Meetings have recently been held in several important districts.

*Wilkes-Barre*—Two interesting papers were presented at the institute meeting held here on Saturday, Jan. 13, one on "Timbering," by John L. Picton, and one on "Who is a Miner?" by Richard Lewis. H. G. Davis, president of the Wilkes-Barre district, presided. The attendance was gratifyingly large, and the discussion most interesting.

*Pittston*—The third meeting of the Pittston district institute was held Monday evening, Jan. 15, and the subject for discussion was introduced by a paper on "Transportation," read by S. J. Jennings, general inspector for the Pennsylvania and Hillside companies. Questions of general interest were answered by Tudor Aston, foreman of Mt. Lookout colliery; John T. Brown, inside foreman for the Erie company, and Edward C. Weichel, general inside superintendent, Butler colliery.

*Carbondale*—On Saturday, Jan. 13, the Carbondale district mining institute held its annual banquet, at which 360 members were present. Two hundred members were added to the roll during a recent campaign. C. L. Fay, of Wilkes-Barre, was toastmaster, and other speakers were as follows: P. J. Moore, state mine inspector and president of the institute; Charles Enzian, U. S. Bureau of Mines; Dr. J. W. Grant, Carbondale, and Mr. Thomas, district superintendent for the Delaware & Hudson company, at Olyphant.

*Nanticoke*—At the meeting here, on Saturday, Jan. 6, papers were read before the Nanticoke district mining institute by William Norton, mining engineer of the Alden Coal Co., and P. F. Devers, district superintendent of the Lackawanna company. John E. Thomas, of the Susquehanna Coal Co. and president of the institute, presided.

*Shamokin-Mt. Carmel*—The institute of this district held a meeting on Thursday, Jan. 11, at Shamokin, at which J. R. Holland, general foreman of the Mineral R.R. & Mining Co. and president of the institute, presided. Papers by John Allen and J. W. Weir were followed by a general discussion and a musical program.

# Coal Trade Reviews

**Current Prices of Coal and Coke and Market Conditions in the Important Centers**

## General Review

The continuation of low temperatures generally throughout the country has placed the coal business in the strongest position it has been in this season. The prolonged summer, with high temperatures prevailing well into the fall, resulted in a light buying movement and a consequent shortage in supplies. The cold weather of the past two weeks, together with the prospects of labor troubles, and some difficulties in transportation, have caused heavy inroads to be made on all available sources of supply, and these have been seriously depleted.

On the Atlantic Coast there has been considerable heavy weather, causing some losses at sea and making arrivals slow; the demand is strong, and with supplies low, it is probable this market will continue active the remainder of the season. In Pennsylvania and Ohio the trade is active and strong, especially in slack. The movement has been slow and some roads are reported as storing in anticipation of a strike; however with their privilege of confiscating any fuel in transit, it is not believed that they will consider it necessary to lay in heavy supplies. The West Virginia operators are viewing the situation with complacency, not only because of the possible labor troubles here but abroad as well; inquiries have been received for coaling the British navy and hopes are entertained of securing some of the English export trade in event of trouble there.

The market in the Middle West continues strong and active with prices advancing and stocks low. The prospects of a famine, as reported in some instances, do not seem probable, as warmer weather will permit the movement of heavy tonnages now standing on side tracks. Colder weather has caused renewed activity in the Western trade, but supplies are reported good and no famine is expected.

## Boston, Mass.

The continued cold is having the usual effect on a market already short of supply. The two days, Jan. 13 and 14, were the coldest in this vicinity for five years.

Bituminous arrivals have been further interrupted, there have been some losses at sea, and conditions generally are materially worse than a week ago. Were it not that practically every consumer, small and large, is under contract, we would have a lively spot market. As it is, every shipper is looking for temporary supplies, and merchants are working together in spreading around what coal is available. Prices are unchanged, from around $4 on cars, but chiefly for the reason that almost no free coal is to be had. Slow loading is reported from the Virginia terminals.

In anthracite there is no improvement. Dealers have tried to be forehanded, but are now hardly able to get more than hand-to-mouth shipments. With a strong retail demand there is little chance to accumulate stocks, as the prudent ones were hoping to do at this time, and an active request between now and Apr. 1 can be put down for certain. Stove and chestnut, as well as the supply of barges, are short, and the delays are getting more and more protracted. The Susquehanna Coal Co. lost the barge "Wayne" in Boston Harbor, on Jan. 13, and other transportation has suffered in the heavy weather.

The Boston retailers advanced broken and egg, Jan. 15, to $7 and $7.50, in each case 25c., making egg the same price as stove, and broken only 50c. less. Water freights are somewhat firmer, $1@1.10 being asked for the larger craft, Hampton Roads to Boston, but with rather few inquiries for so short a market.

## New York

The continued cold weather has made market conditions here considerably firmer. There has been an increase in the spot demand, particularly for the better-grade steam coals, for which there is a ready demand at a price of 10c. a ton higher than was offered last week, without finding a market.

All of the New York piers are having a great deal of difficulty in dumping coal with the result that boats are accumulating and the work of loading is some two or three days behind. There is now some demand for loaded cargoes at prices somewhat above the quotations at which f.o.b. coal can be had. When the cold wave started the market here was rather heavily supplied with coal at the piers so that the slowing up of transportation, caused by severe weather conditions, is only now beginning to show, in a shorter supply at the piers.

Spot prices for steam coals f.o.b. New York, range about as follows: West Virginias, $2.50; ordinary Pennsylvanias, $2.60@2.70; better grade Pennsylvanias, $2.80; with the best grades of Pennsylvania $2.90@3 f.o.b. The high-grade coals are unusually scarce and the market for these is quite firm. There are apparently no accumulations of demurrage coal of any grades at the piers.

## Pittsburg

*Bituminous*—The severe cold snap has seriously disarranged the movement of coal, the temperature having been frequently below zero in the past few days. This has affected both mining and transportation. Mines have been short of cars, have been unable to mine their full quotas, and the coal has moved slowly after loading. For illustration, a case is mentioned of a coal train, such as would ordinarily be moved with one locomotive, which was stalled with four. A few mines are shut down entirely from lack of cars, while others are behind in deliveries and are having a great deal of difficulty in apportioning their output to apply on their different contracts.

Several coal companies on the main line of the Pennsylvania have received communications on behalf of the coal department of the British Navy, indicating that it may be in the market for coal against the possible suspension of mining in England, March 1; on account of the pending difficulty here, such inquiries do not elicit much interest.

Occasionally specially high prices are paid for small lots of coal, chiefly carloads, but in general the market is not quotably changed and we continue to quote: Nut, $1.05@1.10; mine-run, $1.10 @1.15; ¾-in., $1.20@1.25; 1¼-in., $1.35 @1.40; slack, 70@75c. per ton at mine, Pittsburg district.

*Connellsville Coke*—Spot furnace coke continues scarce, and no coke has been sold below $1.80 in the past week, while higher prices have frequently been paid for small lots. Under normal conditions the shortage in production due to the holidays would be over by this time, but the cold weather has given production a fresh setback, and there is the great difficulty in moving coke besides. Nothing has been done on contract. We quote: Prompt furnace, $1.80@1.90; contract furnace, $1.85@1.90; prompt foundry, $1.90@2; contract foundry, $2.10@2.25.

The *Courier* reports production in the Connellsville and lower Connellsville region in the week ending Jan. 6, at 322,906 tons, an increase of 29,000 tons, and shipments at 3314 cars to Pittsburg, 4955 cars to points West and 826 cars

to points East, a total of 9095 cars, a gain of 700 cars.

## Baltimore, Md.

Prevailing zero weather, with all of its discomforts, gave Baltimore operators the opportunity to have their inning during the past week. Prices of all grades of coal advanced from 10c. to 15c. per ton over those obtained for weeks past, and the demand for the product was unusually heavy.

The low grades of coal, which heretofore sold at from 70c. to 80c., advanced to from 90c. to $1 per ton, and were hard to procure at that figure. The best grades of small-vein coal advanced from $1.10 to $1.20 per ton and the supply was limited. The big-vein Georges Creek coal also jumped in price, the trade receiving $1.75 for all that it could deliver.

The movement of coal has not been all that could have been desired, on account of extreme weather conditions, and operators were careful not to book any more orders than they could reasonably care for. Ice conditions in the Patapsco River and Chesapeake Bay have been serious for days, and but few vessels have ventured out. At the coal piers of the Western Maryland Ry. Co., located at Port Covington, several hundred carloads of coal stood on the tracks untouched, and a considerable portion of it could not be loaded into vessels until it had gone through the steaming process. Shippers are hoping that the ice in the river and bay will disappear sufficiently to permit vessels to ply between destined ports.

## Buffalo, N. Y.

There is a special complaint this month from the bituminous trade. There has been a great abundance of cold weather and the volume of business is large, yet the utmost effort on the part of operator or jobber, has failed to advance prices. The inference is that there is always someone willing to sell coal down to cost or the next thing to it. In fact a leading operator said the other day that he was obliged to sell his coal for less now than he received for it last summer. He had always been used to a low price in summer, counting on making his profit in the winter months, but he has so far been unable to get an advance and he finds that others are telling the same story.

There is a somewhat stronger feeling in slack and the increased strength of coke continues. If the improved tone of the pig-iron trade is kept up there ought to be a way before long for the bituminous trade to command a higher price. Quotations continue at $2.50 for Pittsburg three-quarter, $2.40 for mine-run and $2 for slack. Coke ranges from $4.25 for best Connellsville foundry to $3.50 for stock coke. The Allegheny Valley mines are running fairly strong, coal prices being about 25c. less than Pennsylvania.

The demand for anthracite is again away in advance of the supply, there being all of the early shortage of stove, which is already giving out in the Western market. The mining has been slow since the beginning of the holidays, so that the dealers are quite unable to supply their customers. All mining has been slow this month and in some instances the outside operations have been suspended on account of the weather.

## Cleveland, Ohio

In the past week there has been a tremendous scramble for domestic coal, slack, and also railroad fuel. The railroads have been confiscating a great deal of coal for their own use which, in consequence, has hampered this market materially.

Slack has reached the $1 mark the past few days, with little in sight. The weather in the past week has been the severest for a number of years, and while there has not been any actual suffering for the want of coal in the city and vicinity, there was considerable uneasiness on account of so much coal being confiscated and the railroads slow in making deliveries.

The inquiries for coal have been greater in the past week than at any time during the year. Of course, this has been caused from the unusually severe weather. Prices have been firm, but no material advance, excepting in slack, has taken place.

## Columbus, Ohio

With the thermometer hovering around the zero point and often reaching 10 deg. below, and with an improvement noted in many lines of manufacturing, the coal trade in Ohio is now in better condition than at any time in the past six months. Activity prevails in every branch of the trade and operators and jobbers are having difficulty in filling orders promptly because of the lack of motive power on the railroads and a growing scarcity of cars.

The domestic trade is the chief feature in the market at this time. Dealers went into the cold spell with fairly large stocks, but the demand was so strong that they were soon exhausted and orders were placed with the operators and jobbers. Soon immediate delivery was asked and in some instances stocks were difficult to obtain.

Railroads have been unable to move coal shipments promptly because of the heavy snow and extreme cold. As a result there is considerable confusion at the mines and the output in the various Ohio fields has not been as large as might have been the case. Prices are strong and an advance to the usual winter level has been announced by a number of the dealers. Prices prevailing in Ohio are as follows:

| | |
|---|---|
| Domestic lump in the Hocking Valley | $1.50 |
| Domestic lump in Pomeroy Bend district | $1.65@1.75 |
| Three-quarter inch | 1.35 |
| Nut | 1.15 |
| Mine-run in the Hocking Valley | 1.10@1.15 |
| Mine-run in eastern Ohio | 1.00@1.10 |
| Nut, pea and slack | 0.70@0.85 |
| Coarse slack | 0.65@0.75 |

## Cincinnati, Ohio

Extremely cold weather has given this market the stiffest conditions that have been in evidence here for many months; this applies to practically all sizes and grades. Almost anything that can be classed as lump, or nut and slack, will bring a good price, and in almost every case at a considerable advance over what was possible even three weeks ago. Nut and slack is selling at $1 at the mines for the grade that sold a few weeks ago for 80c., and then was piled up at the mines and on cars in the railroad yards for lack of demand.

The weather has been the coldest recorded here this year, and possibly for 10 years.

The demand for nut and slack is even more pressing than for lump coal. The factories are adding their requisitions to the already unusual demand from steam-heating plants. There is hardly a pound of free coal of that character and at least one concern is delivering mine-run to fill its contracts which call for nut and slack, but which is not to be had except the company buy it on the open market.

The river coal men together appropriated a fund of $2500 with which to keep steamers moving in the Ohio River to prevent the freezing of the harbor and its approaches. There is an immense quantity of coal in barges in the harbor together with about 100 empty barges, which might result in serious loss should an ice jam, such as is threatened, form. The river coal is important to the Cincinnati trade, as it is a large element in fixing the price of domestic fuel in the immediate retail market here.

## Thurmond, W. Va.

The cold wave and the probability of a more or less prolonged cessation of work in the anthracite and some of the bituminous fields have all combined to make the New River operators feel more cheerful over the coming prospects.

There has already resulted a rise in screened coal prices, and a steadiness in tidewater, the latter helped by the likelihood of a strike in the entire British coal fields, involving over one million men. It is probable that this strike would result in the loss to the British coals of a considerable amount of export business, more especially in Italy and South America, much of which should go to the high-grade coals of West Virginia. As it is, two or three of the sales agencies in this

field have already made large contracts for export coals, deliveries on which are badly hampered by the extremely high steamship rates now prevailing.

The Chesapeake & Ohio Ry. is making determined efforts to get a large tonnage from that portion of the New River field now served by the Virginian Ry. along the Winding Gulf; the total shipments from the New River field over the Chesapeake & Ohio showing a falling off of 12% in 1911, as compared with 1910. Loading of coal in this field has been fairly good since Jan. 1, notwithstanding the cold weather and heavy snow. Great difficulty, however, has been experienced in getting coal moved, especially to the West, mainly owing to the number of locomotives put out of the service by the unusually low temperatures.

## Charleston, W. Va.

The cold weather has cut down the output in the state and sent up the price of coal except that held down by contract. It has been many years since a cold spell has lasted as long as the present one. The heavy snows and extreme cold, ranging from 5 to 25 deg. below zero, have not only prevented the handling of cars but has otherwise interfered with the mining of coal. Lump and egg has taken a jump, also run-of-mine. Kanawha lump is bringing from $150 to $1.70 at the mine, with run-of-mine at about 95c. New River run-of-mine ranges from $1.20 to $1.45, and New River egg at from $1.60 to $1.70. Indications just before the first of the year were that the output for January would exceed that of last year, but the extreme cold may be the means of cutting it down below a year ago. The jump in prices, however, has been the one really satisfactory movement in the situation during the past 10 days; continued cold weather will probably cause a still further advance.

## Louisville, Ky.

Activity such as had not been seen in many years was evident in the local market during the past week, due to the unprecedented cold spell. That which was true of the Louisville market was true of practically every city and town in Kentucky.

While the dealers were busy day and night in filling orders, the charity stations and the relief desk at the office of the mayor were also overwhelmed with applications. For the first time in many years few questions were asked when an applicant who even looked the part made his or her appearance. So widespread was the suffering that few of the poor were able to provide from their own incomes sufficient fuel to supply their wants.

The average prices which prevailed were as follows: Pittsburg, $3.75; Jellico, $3.60; Winifrede, $3.60; Taylor, $3.25. Pocahontas smokeless brought $4.75, and New River Smokeless, $4.50. Kentucky lump continued to sell as low as $3 for a 2000-lb. ton, and Banner lump, $3.25. Straight Creek lump brought $3.75; nut and slack, $2.25, and Gem selling at $3.

A shortage in steam coal which promises to be serious, is also causing much concern. The manufacturers here have been warned that the inactivity at the mines around the Christmas holidays, and the delay in shipments following the heavy snow fall, are elements to be considered. The local dealers have been forced to rely upon their reserve supplies for coal for manufacturing purposes. How long they will be able to meet the demands from this source seems to be questionable.

## Memphis, Tenn.

Memphis is in the middle of the best coal selling weather that we have experienced for 12 years. We are having severe weather with the temperature low and a strong wind blowing from the north, laden with snow and sleet. The retail yards in Memphis have drawn heavily on their stocks and the smaller dealers have practically exhausted what they had in storage.

While there has been no advance in price, it has given the mines about all they wanted at prevailing prices, which are as follows:

| | |
|---|---|
| Kentucky No. 1 lump | $1.50 |
| Kentucky No. 2 lump | 1.25 |
| Kentucky No. 1 nut | 1.10 |
| Alabama No. 1 lump | 2.00@2.50 |
| Jellico lump | 2.00@2.25 |
| Jellico block | 2.25@2.50 |
| Round coal | 1.65@1.90 |
| Cahaba coals | 2.50@3.00 |

These maximum prices are being secured in isolated places. Screenings are scarce, and it is impossible to secure sufficient to take care of the steam business for this section.

## Nashville, Tenn.

Nashville and vicinity are in the midst of the blizzard which is taking in the entire country, and just as was predicted several weeks ago, the unprecedented cold spell has caught all the dealers short of coal.

The usual trouble around the mines with freezing weather and snow, retarded considerably the loading of coal. This together with the shortage of cars on the one week when every mine in the field could have run, full capacity, added much to the demoralized condition.

There is still a big demand for screenings at the top market price. Outside of this there has been no relative change in this field over recent quotations. Some few people, as an extra inducement to have a little spot coal shipped immediately, have seen fit to offer a slight advance on the regular prices, but this condition has not prevailed to any extent.

## Indianapolis

Continued cold weather has caused all coal mines in the state to work full time, with large forces, to supply the demand. Previously, the mines had been worked on an average of about half time. Many Indiana cities, depending on natural gas for fuel, have sent rush orders for coal, the gas supply being insufficient.

The indications are that the demand will continue, since big consumers have begun to store in anticipation of the miners' strike after Apr. 1. The operators are, however, somewhat pessimistic, believing the cold weather will not last and that the strength of the market will vanish. It is too late for retail dealers to stock up heavily since they have been turning their surplus into cash.

## Chicago

Wholesale prices in the Chicago coal market are on a higher average level than they have been in the last six years. Severely cold weather, with the mercury below the zero mark most of the time, gave a sky rocket turn to the price situation that caused a stir in every direction.

On steam coals the rise has been far more rapid than on those of the domestic variety. Smokeless mine-run has risen from 80c. to $1.10 on shipments direct from the mines, with a strong tendency toward another jump to $1.15. Lump and egg sell wholesale at $2.15 to $2.25. Splint coal, which sold a short time ago for $1.10 to $1.25, moves freely at $1.55 to $1.60. Low grade screenings have risen almost 100% and a boost of 50% in other sizes has not been unusual.

Prevailing prices at Chicago are:

| | |
|---|---|
| *Sullivan County:* | |
| Domestic lump | $2.62 |
| Egg | 2.62 |
| Steam lump | 2.20 |
| Screenings | 1.87 |
| *Springfield:* | |
| Domestic lump | $2.57 |
| Steam lump | 2.32 |
| Mine-run | 2.27 |
| Screenings | 1.82 |
| *Clinton:* | |
| Domestic lump | $2.52 |
| Steam lump | 2.25 |
| Mine-run | 2.15 |
| Screenings | 1.77 |
| *Pocahontas and New River:* | |
| Mine-run | $3.15@3.30 |
| Lump and egg | 4.20@4.30 |

*Coke*—Prices asked for coke are: Connellsville, and Wise County, $4.50@4.65; byproduct, egg and stove, $4.85; byproduct, nut, $4.55@4.65; gas house, $4.85.

## Minneapolis—St. Paul

The local coal market has shown great activity during the past week. The weather has continued cold, stocks have been diminishing at a rapid rate and some dealers are looking for a coal famine. This is not probable, however, as a

day or two of milder weather would allow the railroads to bring in hundreds of cars of coal which is now stalled on side-tracks on all the roads.

This stretch of 20 deg. below zero weather has played havoc with the railroad service. The Great Northern reported Friday that they had 1400 loaded cars of coal at their yards in Duluth, but were unable to move them. A frozen car, they claim, pulls twice as hard as under normal conditions, and a frozen engine uses up one-half its energy in moving its own weight. Retailers' stocks are low on all grades of coal, but especially on anthracite. A canvass along the H. & D. division, which supplies the large resident district of Minneapolis, shows there is a shortage on all grades of anthracite, and only one car of stove size was found at any of the twelve yards.

## St. Louis, Mo.

The coal market in St. Louis is in an extraordinary condition, which has obtained since the middle of last week, when the weather went down to 10° below zero and was followed by snow. The snow held up the railroads and ice blocked the ferries on the river to such an extent that the yards in East St. Louis were congested and it was impossible to get coal across.

Carterville coal is worth in the neighborhood of $1.50 for the larger sizes, and there is an unlimited market for the smaller sizes at almost any price the shipper demands. This same condition applies to the Franklin County coal, but this product is moving almost exclusively into the Northwest.

The local demand for anthracite has been exceedingly good, but shipments are hard to get. The same condition applies to smokeless lump and egg; gas-house and byproduct coke are in good demand, but it is almost impossible to get shipments. There is no coal coming in from the Saline or Springfield districts, as these coals are in demand in the Northern market, where they are bringing a better figure than St. Louis could stand. A small tonnage of Arkansas anthracite is moving in, but not enough to relieve the market any.

## Portland, Ore.

Portland had a touch of real winter weather during the week. It was in the nature of a silver thaw, which means that telegraph and telephone wires, trees and fences became coated with ice to a thickness of an inch or more and with disastrous results because of the crushing weight.

The coal and fuel dealers in general were buried under orders that poured in at an amazing rate and which were difficult to fill promptly. One fuel dealer stated that business increased about 300% during the first days of the cold snap.

Train service was tied up in eastern Oregon during the storm, but not sufficiently to cause any disturbance.

## Spokane, Wash.

Coal has been in a great demand in the territory known as the Inland Empire during the last week, but the prices have remained stable. The cold weather is drawing upon the stocks to a considerable extent, but the mines are furnishing their share, and the demand is easily met. Indications are that the cold weather will continue for a few more days, and in the meantime the coal dealers are doing their best. Prices are as follows:

| Kind | Wholesale | Retail |
|---|---|---|
| Rock Springs | $7.20 | $9.00 |
| Owl Creek | 7.20 | 9.00 |
| Kirby | 7.20 | 9.00 |
| Carney | 6.70 | 8.50 |
| Bearcreek | 6.35 | 8.25 |
| Roslyn steam | 5.25 | 6.25 |
| Canadian steam | 5.25 | 6.25 |

## Foreign Markets

### Great Britain

The tonnage position is satisfactory, and there is a good tone to the market. Prices, however, are about unaltered and are as follows:

| | |
|---|---|
| Best Welsh steam coal | $4.14@4.20 |
| Seconds | 4.02@4.08 |
| Thirds | 3.78 |
| Best dry coals | 4.02 |
| Best Monmouthshire | 3.78 |
| Seconds | 3.60 |
| Best Cardiff small coals | 2.16 |
| Seconds | 1.92 |

The above prices for Cardiff coals are all f.o.b., Cardiff, Penarth or Barry, while those for Monmouthshire descriptions are f.o.b. Newport, both exclusive of wharfage and for cash in 30 days less 2½ per cent.

## Production and Transportation Statistics

### Norfolk & Western Ry.

Statement of commercial and company coal from mines on the Norfolk & Western Ry. for the month of December, 1911, is as follows in net tons:

| From | Commercial | Company |
|---|---|---|
| Pocahontas field | 1,112,126 | 97,748 |
| Tug River field | 147,107 | 44,100 |
| Thacker field | 167,232 | 63,831 |
| Kenova field | 68,885 | 9,357 |
| Clinch Valley field | 91,032 | 7,194 |
| Total | 1,586,382 | 222,230 |

The following are shipments from the different fields in West Virginia:

| | Transfer Coal | Tipple Coal | Total Coal |
|---|---|---|---|
| Pocahontas | 1,142,793 | 22,358 | 1,165,151 |
| Tug River | 188,506 | 2,701 | 191,207 |
| Thacker | 226,431 | 4,632 | 231,063 |
| Kenova | 70,586 | 7,656 | 78,242 |
| Total | 1,628,316 | 37,347 | 1,665,663 |

Total coke shipments, originating entirely in the Pocahontas field, were 96,609 tons.

### The Car Situation

On Jan. 3 there were 135,938 more cars on the lines of the members of the American Railway Association than the demand called for. This was a big increase from the statement of the previous fortnight, when the surplus amounted to 76,814. That in turn compared with a surplus of 36,143 as of Dec. 6. Most of the increase in the latest report resulted from a falling off in the movement of coal.

In the two weeks ended Jan. 3 the surplus of coal cars increased from 35,409 to 64,719, and the surplus of box cars increased from 23,485 to 36,145. Miscellaneous and flat-car surpluses followed the general trend with considerable increases.

On the corresponding day last year the net surplus of idle cars was 106,924. Two years ago it was only 38,416; in 1909, 332,513, and in 1908, 341,100.

## Financial Notes

The Northern Securities Co. reports the earnings of the Crow's Nest Coal Co. for the year ending Dec. 31, 1911, at $27,552. Earnings were curtailed because of the strike.

Monongahela River Coal & Coke Co. has declared a dividend of $2 a share on the preferred stock out of earnings for fiscal year ended Oct. 31; payable Jan. 25 to stock of record Jan. 22.

Consolidation Coal Co. has declared the regular quarterly dividend of 1½% on the capital stock and a dividend of 1½% on the subscription receipts for stock carrying dividends declared after Jan. 31, 1911, both payable Jan. 31 to stock of record Jan. 26.

Virginian Ry. proposes to increase its stock from $36,000,000 to $65,000,000 through issuance of $29,000,000, 5% cumulative preferred. Matter comes before stockholders at annual meeting here Jan. 27, but Rogers estate is believed to own all the road's common stock save $500,000. Belief is that extension to the Great Lakes through acquisition of other railroads or through building is contemplated.

The board of directors of the Lehigh Valley R.R. Co. has authorized the distribution of $6,060,800, or 10% on the total outstanding stock, payable Feb. 26, 1912. Coincident with this the Lehigh Valley Coal Co. has authorized the organization of the Lehigh Valley Coal Sales Co., with a capital stock of $10,000,000, consisting of 200,000 shares of the par value of $50 each, of which 121,216 shares of the par value of $6,060,800 will be immediately issued. The readjustment is made necessary by the decision of the supreme court rendered in May, 1909, by which it was held that a railroad company cannot lawfully transport coal owned by it.

The preferred and common stock of the New River Co., owned largely by Boston and Pennsylvania people, has just been listed on the Boston Curb Exchange. The bonds of this company are already listed on the Boston Stock Exchange. This stock was widely distributed in 1906 through a number of local interests and the company sells much of its product through Maine, Massachusetts and Rhode Island. The preferred stock paid dividends through 1907 and 1908, but has not paid since then. The listing on the Boston Curb has been at the application of large shareholding interests who desire to see a broad, natural market in the stock.